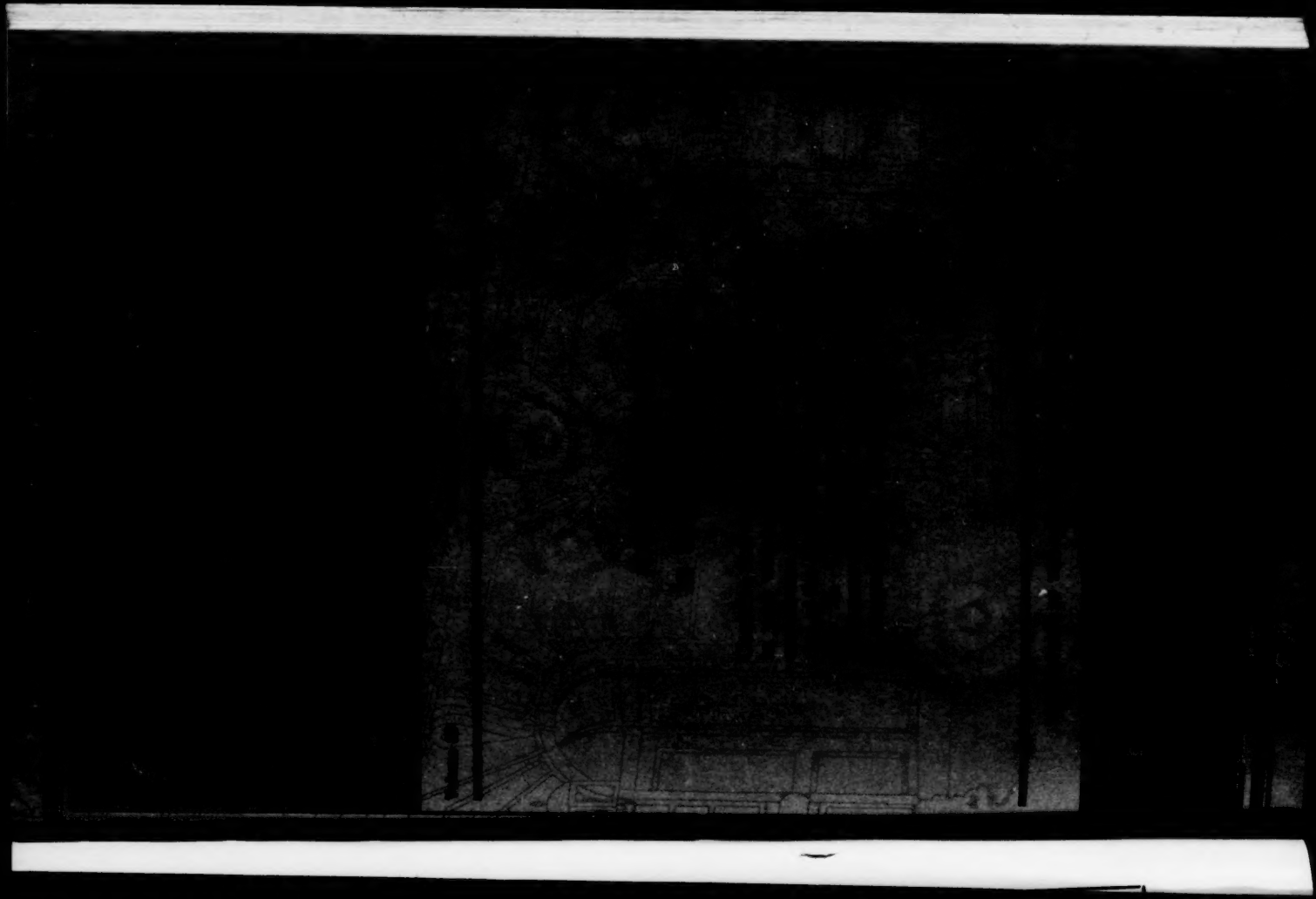

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# The Bulletin

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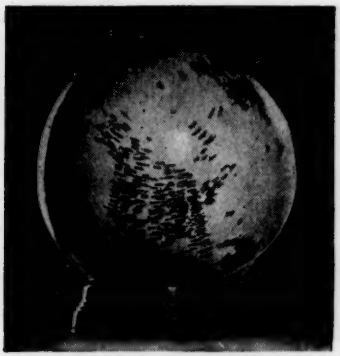
PAUL E. ELICKER, *Executive Secretary*

PAUL E. ELICKER, *Editor* WALTER E. HESS, *Managing Editor*
1201 Sixteenth Street, N. W., Washington 6, D. C.

**EDUCATION IS NOT A DESTINATION . . .**
**IT IS A JOURNEY . . . ALWAYS, WE ARE EN ROUTE**



*Surface Globe* *Air Globe*

THROUGH the ages from the flat world to today, man has made a succession of attempts to depict planet earth on maps and globes.

Surface maps and globes filled all needs until the realm of air was used for vehicular traffic above the earth's surface. Now, surface maps and globes tend to defeat an effective understanding of the meaning of the oneness and the sameness of air, available impartially to all peoples everywhere. The very "pictures" that are necessary for a terrestrial globe reveal the barriers to swift, universal surface communication and transportation.

The plural nature of the earth's surface keeps people apart. In contrast, the singularity of air makes it possible to unite all peoples. Every place and person on earth is accessible by air because air is everywhere and all air is navigable for all kinds and sizes of aircraft.

Air Globe shows only the names of places and dots to give their location because these places symbolize *people*. It underscores the lasting truth uttered by Protagoras of Abdera, ancient Greek philosopher who said, "Man is the measure of all things." It emphasizes the rapidly mounting interdependence of all mankind.

Educators are in a position, and have the responsibility, to interpret the far-reaching impacts of air transportation upon world society. We invite you to send comments, suggestions and questions to Air-Age Education Research and to request a free copy of "Air Age Education News."

*Air-Age Education Research*

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# The Educational Road is Open

*By Edgar Fuller*

THE SIX state plans for aviation education printed here have resulted from efforts of organized education to meet a major educational challenge of our time. They recommend that this dynamic influence on modern living be utilized in the schools to enrich learning.

The plans agree that certain branches of aviation education prepare students for the military air forces, vocations in aviation, or personal flying, but that these are only specialized segments of the great scientific and cultural aspects of the air age which affect all mankind. They recommend that every citizen should have considerable knowledge about aircraft, about the great principles of modern science which are best illustrated by aircraft, and about the supreme importance of aviation in the present and future social, political, and economic relationships of men and their institutions.

These state plans differ in details, but they are all educationally sound. They are based on a fundamental fact of American educational structure—that education is primarily a function of the state—and for this reason the suggested programs can be placed in full effect only as states and school districts overcome certain financial and legal obstacles. Elimination of these obstacles is particularly necessary to inaugurate the laboratory flight experience recommended for high-school students in all six plans. This portion of the program will be conducted experimentally in a few schools during the current school year, probably financed privately in most instances. As it proves its worth and as experience is gained in its administration, it will find its proper place in our educational systems. Many of the other recommendations are already in effect in the better schools of each state.

The most important fact in the entire situation is that the organization of aviation education in our country is still in a developmental stage, with the result that schools and colleges are free to make it an integral part of our educational systems. We may be hopeful that boys and girls will not be forced to go outside the regular school systems and colleges to obtain the aviation education they desire and should have.

Our schools are rapidly recognizing the implications of human flight. Most teachers know that established courses and teaching procedures in the sciences, social studies, and other fields must be adapted to the implications of human flight as well as to other modern needs. These changes demand a critical examination of our present curriculum materials and content. Boys and girls often seem to find special delight in challenging the few teachers who still have difficulty in distinguishing a DC 3 from a Cub. Life would be simpler if the airplane had not been developed at all. But the air age is here, and teachers find that effective teaching demands knowledge about airplanes and under-

standings about how they are changing world relationships. Only with such knowledge and understandings are teachers able to deal realistically with the generation now in schools.

## I. INSTRUCTION IN SCHOOLS

A large proportion of the elementary schools enrich their programs in all fields by using aviation materials. Teachers of units on transportation, geography, communications, cultures of other lands, fine arts, language arts, shop work, mathematics, and the various fields of science utilize the interest of students in aviation to make learning more effective and more germane to the realities of the modern world. A program of enrichment, similar to that in the elementary schools, is also found in the secondary schools. Here such subjects as social studies, general science, physics, mathematics, industrial arts, and biology are commonly taught with the airplane, its operation, and its social effects as important influences in the class activities.

The secondary schools also offer regular courses more or less directly related to the airplane. Most common is the science of aeronautics, which is now offered as a full-year science course in a large proportion of the senior high schools of the country. This course ordinarily includes aerodynamics, aircraft structures, meteorology, air navigation, power plants, radio communications, and civil air regulations. These technical units are usually taught with considerable attention to their social, political, and economic effects, and with laboratory exercises in connection with the classroom work. Such courses are of great direct importance to modern society because they teach scientific principles of the utmost importance in the most interesting and effective manner. Aviation teachers realize that science works both for and against mankind, and that students should not only be taught scientific principles, but also how to utilize science for individual and social progress.

Aviation courses affect students, in a vocational sense, somewhat like a course in biology affects the students who study it. A biology course in high school may be the beginning of the training of doctors, dentists, nurses, and medical technicians. But a biology course contributes only to the general education of most of the students who study it, because most of them never enter the medical callings. Yet the biology course is still fully justified, because it helps every student understand himself and human society. In a similar way, courses in aviation may lead to better understandings about the great social revolution which modern science has brought upon the world. The most startling developments of this social revolution are closely related to the fact that humans fly freely, for good or ill, all over the world. The effects of aviation may range from the use of the airplane as an angel of mercy to the further development of the horrible robot bomb, depending on how we manager our technical knowledge. These are understandings of paramount importance to all citizens.

Aviation courses condition many students for personal use of airplanes as passengers or customers of cargo-carrying airlines, for private, commercial, or military flying, or for vocational participation in aviation professions, trades, or business. These pre-vocational results are in addition to the general education received by these groups. But the teaching of aviation in the secondary schools is not primarily an effort to produce pilots or workers in aviation. First of all, aviation education is an indispensable part of the general education of every citizen of our country.

## II. INSTRUCTION IN THE AIR

Some first-hand experience in flying will go far to make certain that the purposes of aviation education are achieved. One important problem in the teaching of aviation therefore concerns development of a flight experience curriculum which will result in effective laboratory work. This is new to the schools, and for this reason a disproportionate amount of space is given to it here. Each of the several state committees on aviation education, whose recommendations are published in full in this *Bulletin,* have agreed on four hours of flight experience in a dual-control airplane for each high-school student of regular aviation courses. Of what shall this flight experience consist?

It is clear that the first four clock hours of the former Civilian Pilot Training flight curriculum do not fulfill the objectives of the proposed laboratory experience programs. Neither are the flight curriculums of the Army, Navy, or former War Training Service of the Civil Aeronautics Administration adequate for these purposes. This is in no way an adverse criticism of any of these programs. They have been carefully worked out for the training of pilots and for this purpose they have been efficient. It is clear, however, that the objectives of the pilot training programs differ substantially from the objectives of the laboratory flight-experience programs which are the likely pattern of the future in secondary schools.

The pilot-training agencies have properly devoted the first four hours in the air to development of piloting skills through repetition of a limited number of elementary maneuvers. On the other hand, the hours of flight experience each student receives as a part of the regular aviation courses in the high school are intended to demonstrate the scientific principles of aerodynamics, meteorology, air navigation, power-plant operation, aerial communications, and Civil Air Regulations, together with the practical operation of these principles in the air. Although most students will pilot the airplane during their four hours in the air, their time would not be used to best advantage in repeating elementary maneuvers which are necessary for development of piloting skills. A new curriculum must be organized which will utilize their flight time more effectively as a part of the laboratory experience in connection with aeronautics courses in secondary schools.

It is obvious that only a few of the most important scientific principles of

aeronautics can be demonstrated within a period of four flight hours, yet the consensus of opinion among flight instructors and other educators is that, if more than four hours experience is given to a student, his instruction should be continued until he can be certificated as a private pilot. This is because they believe it unsafe to take the student as far as the solo stage or near the solo stage (ordinarily about eight hours of dual instruction) and leave him there. A student might then believe himself capable of flying an airplane alone when it would be better for him and for society if his training were continued until he became fully qualified as a private pilot. It is not the purpose of the laboratory flight experience to teach a student to fly an airplane.

Another reason for fixing a limitation of four flight hours for each student is that complete training of private pilots would increase the cost so much that only a few students would be able to fly at all. This would deprive most high-school aviation students of all flight experience, and the objective of the flight curriculum would then become the training of pilots rather than the demonstration of scientific principles of aviation as learned in the classrooms and aviation shops.

These hours in the air can be made four of the most meaningful hours of the high-school course. They involve first-hand student experience with probably the most significant development of modern science. Laboratory work gets results according to how close it is to the real thing; here is an opportunity to use flight itself instead of relying completely on bookish substitutes.

Careful thought should be given to relative values within the flight curriculum. Consider, for instance, a flight intended to give students experience in comparing differences in temperature and air density near the ground and at a high altitude. Such an altitude flight would obviously give opportunities for studies of the effects of altitudes on airplane performance and on the human body. But ascent to the service ceiling of a light airplane requires a considerable amount of time which must be justified in terms of these multiple benefits as a laboratory experience. Measurements may be difficult to make in an accurate manner. Relative educational values must be examined carefully where time is so limited and there is so much to do.

Suitable flight instructors must be provided for the proposed program, because repetition of maneuvers for the purpose of developing piloting skills must give way to a different brand of teaching. Yet the change from pilot training techniques is not the only difficulty. In some of the schools which have made a limited amount of flight available to large numbers of students, the flight program has consisted only in "taking the students up for a ride." This is perhaps even less an adequate experience in laboratory work than a similar length of time spent entirely in drilling on elementary maneuvers. The flight instructors must be effective teachers of science as well as competent and trustworthy teachers of flight.

After more schools have conducted flight programs, they will undoubtedly change their emphases as new methods are developed in practice, for experience with flight programs for general education purposes is still limited. The flight curriculum has developed from state to state during the past year; attention is called to the "Airport Laboratory Plan" pages 174-185 in the most recent of the state reports printed herein. We may hope that a flight curriculum will eventually be worked out which will demonstrate the more important scientific principles which are ordinarily studied in a typical one-year high-school course in aviation.

*The National Association of Secondary-School Principals is deeply grateful to the Civil Aeronautics Administration, Department of Commerce, and its Director of the Aviation Education Service, Mr. Bruce Uthus, for the encouragement and active interest in the publication of this special issue on aviation education. The Association gives special acknowledgment to Mr. Edgar Fuller, Principal Educationist, Aviation Education Service, Civil Aeronautics Administration, formerly of the Harvard Graduate School of Education, for his indefatigable work and counsel with many educational leaders throughout the country in consulting with them on the principles of education implied in a program of aviation education. Many others, including the state conference groups in the many states, have given invaluable aid in the development of this educational project.—The Editor.*

# State Plans of Aviation Education

MANY OF the schools of the nation have recognized the importance of aviation education. As evidence of this recognition, a large number of high schools are offering either full-year courses in the science of aeronautics or related subjects or have introduced aviation materials in existing courses. The six state plans for aviation education printed here are representative of programs that have been developed by state committees in consultation with a representative of the Aviation Education Service of the Civil Aeronautics Administration.

The world's entrance into the air age has created unique responsibilities for educators. The pressing obligation of schools to educate youth for life in a shifting era is not the simple task of merely re-applying conventional educational procedures. The educational challenge of this air age has grown complex, insistent, and immediate. Young people require a thorough introduction to the scientific principles which underlie flight. The problems are so urgent that schools should respond promptly and vigorously to a rare opportunity to influence, guide, and shape an emerging era. It is with these thoughts in mind that the following six programs are offered as aids to state departments of public instruction and individual high schools within the states. It is hoped that these representative programs will be helpful to other states that have not already developed, or are in the process of developing, an aviation education program.

## WISCONSIN*

JUDGING from the many inquiries which school administrators and teachers are constantly directing to various members of this Department, and recognizing that our entrance into the air age has created unique responsibilities for educators, it is believed that specific recommendations on aviation education should come from this office as guides for local schools.

This report is an outstanding example of local, state, and Federal co-operation in education. This is the first complete state plan of aviation education. You will find many suggestions for the development of general aviation education programs on the elementary, secondary, and college levels, as well as a detailed outline for a full-year course in the science of aeronautics for high schools.

I believe this report will help you plan your programs for the coming school year.

**JOHN CALLAHAN**
**Superintendent of Public Instruction**

*The first of the six comprehensive state plans for aviation education, printed here in full or in part, was developed in Wisconsin early in 1944. Since this report was published in *The Bulletin of the National Association of Secondary-School Principals*, April, 1944, only a few excerpts are herewith reprinted. For this suggestive program on flight experience as laboratory work, the reader is referred to the Illinois program found on page 30-36 of this publication.

THIS IS a report on the purposes of aviation education, with suggested programs for the schools of Wisconsin. It is submitted to the local educational authorities of the state for their consideration, not as an exact definition of what should be done, but rather as a framework which may be adapted for the use of each school. Brief references have been made to aviation education in the elementary schools and in colleges and universities, with major emphasis on programs for secondary schools.

The report is a co-operative enterprise, with local, state, and Federal participation, but all suggestions made are intended to fit into the present system of education in Wisconsin. Idealistic programs which would be unlikely to be adopted have been avoided. Recommendations have been limited, rather, to practicable plans for extension and improvement of the work of the schools as they are now operated.

The requirements of all the subjects and areas of learning taught in the schools have been carefully considered in the preparation of this report. Especial attention has been given to co-ordination of aviation education with the established high-school science studies and with new areas of scientific learning not included in aviation education.

There is no proposal of any Federal program of aviation education in this report, and there is no implication that there is to be Federal financial aid for any of the programs recommended. All organization, financing, and control of these programs are intended to be left to the state and local educational authorities, except in so far as safety requirements of the Federal statutes must be met.

## COURSE CONTENT AND METHODS OF INSTRUCTION

The contents of the aeronautics course and the methods of teaching it should be given careful attention. Although the course is primarily a study in science, its social implications are among its greatest values. The scientific phases of aeronautics may be related in the classes to the social effects of the air age. For example, study of civil air regulations leads to discussion of certain responsibilities of citizenship, distribution of airports in relation to population, and governmental control of domestic and foreign aviation for the general welfare. Study of air navigation involves geographical concepts. Study of weather will raise questions about the feasibility of certain types of military, commercial, or private flying in many parts of the world.

The social implications of the air age are likely to develop somewhat in proportion to the development reached in conventional airplane engines, wings, propellers, and other parts of the airplane, or in flying machines of novel types. Students should understand that the advance of aviation technology will increase its social impacts on civilization, and they should be led to consider the technical and social factors together. Although the aeronautics course is outlined generally in terms of scientific outcomes, the committee strongly encourages concurrent consideration of the social implications of aviation.

### QUALIFICATIONS OF TEACHERS

Instructors for aeronautics courses should be selected according to the standards used by the school in the selection of instructors for other phases of science teaching. The most important factor is to procure a man or woman who is a good teacher. Other important factors in the selection of a teacher are: (a) background of science and mathematics; (b) interest in aviation; (c) specialized training in the subject matter of aeronautics; (d) flight experience as a student flyer or as a passenger; and (e) experience as a private or military pilot or navigator, or special experiences in meteorology, aircraft communications, or other activities connected with aviation.

### COURSE PREREQUISITES FOR ADMISSION

Academic prerequisites for admission to the course should ordinarily be one course in high-school science and one course in high-school mathematics. Local school authorities should consider the advisability of admitting out-of-school youth on the same terms upon which special students are admitted to other high-school courses.

### AERONAUTICS IN SMALL HIGH SCHOOLS[1]

Small high schools often find it necessary to plan their offerings with limited funds, equipment, and teaching personnel. Fewer courses can be offered than in larger schools. Many small schools may be unable to offer a separate course in aeronautics, and may thus be compelled to restrict their offerings in aviation to materials incorporated within other subjects. In spite of the restrictions which accompany small size, however, some small high schools now offer successful year-long courses in aeronautics. Where this is done, it is recommended that the aeronautics course which has been outlined below should be offered in alternate years as an *elective* science for boys and girls of the junior and senior classes. Other small high schools may care for the needs of individual students who desire an aeronautics course through the correspondence study facilities of the Extension Division of the University of Wisconsin.

### AERONAUTICS IN HIGH SCHOOLS OF MEDIUM SIZE

In high schools of medium size, *i.e.*, those having more than five but less than twelve teachers, the course outlined below is recommended for juniors and seniors, with the same suggestions as for smaller schools concerning instructors, admission requirements, and emphasis on social implications. For most schools of these sizes, however, it is recommended that the course be offered each year.

### AERONAUTICS IN LARGE HIGH SCHOOLS

In large high schools, *i.e.*, those having twelve or more teachers, it is recommended that the course outlined below be offered each year in approximately the same manner as in the smaller schools. It is suggested, however, that indi-

[1] Tabulations show there are 141 public high schools in Wisconsin with 5 or less teachers; 176 with more than 5 but less than 12 teachers; and 143 with 12 or more teachers.

vidual schools of these sizes also experiment with the offering of an additional course in modern science in the tenth grade. If this were done, students would be prepared for somewhat more advanced or specialized courses in physics, aeronautics, radio, mechanics, and the like, in the eleventh and twelfth grades. The suggested tenth-grade course should cover the important phases of elementary aeronautics, but it should also be organized so that other phases of modern science, such as radar and electronics, might be included. A course of this type might be developed by shortening or omitting altogether some of the units in aeronautics outlined below while adding units in other important phases of modern science which would be appropriate for tenth-grade students.

OUTLINE OF OBJECTIVES OF A COURSE IN AERONAUTICS RECOMMENDED FOR GRADES 11-12

1. *Implications of the Airplane for Society* (5-10 class periods)

An understanding of the manner in which the airplane is changing our ways of living.

An understanding of the effects of the airplane on warfare.

An understanding of the probable effects of the airplane on our national life and on our international relations.

An understanding of the probable extent of commercial aviation and private flying after the war and its significance for the lives of students now in secondary schools.

2. *Aircraft Structures* (5-10 class periods)

A knowledge of classes and types of aircraft and their uses.

An understanding of the strengths and limitations of important aircraft structures.

3. *Aerodynamics* (30-40 class periods)

An understanding of the basic principles of flight and simple aerodynamics.

An understanding of the flight characteristics of airplanes and their operational limitations, including stalling speeds, load factors, and other items.

An appreciation of the necessity for keeping aircraft in proper maintenance and repair, and a knowledge of some common practices of good maintenance.

4. *Civil Air Regulations* (12-18 class periods)

An understanding of the need for uniform regulations for pilot certificates, control of air traffic, and equipment and maintenance of aircraft.

A knowledge of the principal flight regulations and traffic rules.

An understanding of the privileges and limitations of private and commercial pilots.

A knowledge of the proper pilot care and inspection of aircraft and power plant and their relationship to safety in flying.

5. *Power Plants* (25-35 class periods)

An understanding of the functioning of an aircraft engine, including fuel, ignition, cooling, and lubrication systems.

An understanding of the importance of proper engine operation and its relationship to safety in flying.

A knowledge of types of propellers and how they operate most effectively.

An understanding of the structure, functions, and possible inaccuracies of the various engine instruments.

6. *Meteorology* (30-40 class periods)

An understanding of the relationships and importance of meteorology to safety in flying.

An understanding of the characteristics of the atmosphere, air masses, fronts, clouds, and other phenomena associated with weather.

An understanding of the facilities of the Weather Bureau available to the pilot.

An ability to interpret and use weather maps and reports in connection with flying.

7. *Air Navigation* (35-45 class periods)

An understanding of various map projections and an appreciation of the limitations and errors of each.

An appreciation of the necessity for careful work and accurate understanding in calculating all navigation problems.

A knowledge of the principal elements of contact flight and dead reckoning.

Development of some skill in the solution of dead reckoning problems.

A knowledge of radio operation as an aid to air navigation.

The above schedule is planned for an average of 170 class periods, although there is allowance for courses ranging between 142 and 198 class periods in length. It is intended that each school shall adapt its schedule to allow for the time required for flight experience and other laboratory exercises. The flexibility of the schedule is intended to suggest that each instructor shall make such adaptations in the number of class periods spent on each of the seven subdivisions of the course as may seem best for his particular class.

## ILLINOIS

RECENT SURVEYS indicate that the schools of Illinois are very much interested in a program of aviation education. Today a high per cent of the high schools are offering some type of work in aviation education ranging from units on aviation in science courses to full-year courses in the science of aeronautics.

As interest in this new science has grown, new demands have come from school people for more definite outlines and criteria for the work. In answer to this demand, schoolmen of the state, representing different levels of education, have developed a statement in regard to what they believe can be accomplished in the development of a program of aviation education beginning in the elementary school and extending into the college. The program is herewith presented.

In the development of this program, representatives of elementary education, including county superintendents of schools, superintendents of large and small city schools, principals of large and small high schools, and representatives of industrial and vocational education have had an opportunity to express their opinions in regard to what should comprise an aviation program.

The offering of aviation education in our schools represents a response to new demands which are outgrowths of an ever changing civilization. Without recognition of these changes, the school fails in its obligations to society. Certainly the new conditions created through the invention of the airplane and the expansion of its uses in this twentieth century are sound reasons for the revision of the school curriculum to include a study of aviation.

The new developments in a progressive world should not immediately demand a revolutionary change but should call for the intelligent and logical examination of possible new approaches and procedures. As our world enters the new air age, society will expect its schools to readjust its offerings in those ways which will be of greatest benefit to the present society. Today the opportunity is at hand for educators to recognize and do something about the problems of the new air age, which may prove as forceful in our day as did the Industrial Revolution in an earlier age.

In meeting the demands of the air age, all changes must be made with the general aims of education clearly in mind. One of the important aims of education is to prepare the individual to meet and solve life's problems in the best and most satisfactory manner possible, both to the individual and to society. In the solving of life's problems, a broad knowledge of our physical world, as well as a knowledge of our social structures, is important. In my opinion the new air age forces us to a major re-interpretation of both our physical and social world. This will naturally call for some basic changes in the offerings of the school, one of which is a new approach to general education.

**VERNON L. NICKELL**
**Superintendent of Public Instruction**

## THE IMPORTANCE OF AVIATION EDUCATION

TO A GREATER degree today than ever before in the history of the world, victory in war is a technical achievement. While masses of soldiers are still important in winning battles, the quality of the arms they possess, the protective and supply services which are correlated with them, and most of all the offensive striking power of special instruments of modern warfare such as tanks and airplanes—these are absolutely indispensable to secure a victory of armies.

Naturally, therefore, the war effort has turned on the forced draft in all areas of technological development. In no field has this been more true than in aviation. Aviation has seen a steady growth since the last war. Planes have been vastly improved, commercial flying has become a commonplace, intercontinental air service has been started, and an increasing number of private individuals have purchased and learned to fly their own planes. The present war has put a tremendous pressure on technical research in the field, and progress in the last few years has been at so rapid a rate that although it is now impossible to prophesy what changes in human living will occur in the postwar period, at least we do know that no nation or individual in the world will be untouched by them, and that in nations of scientific achievement, the changes will be profound.

These changes will bring with them many serious problems in economic, political, and social life. If we were living in an autocracy, these problems would need to concern the common man very little. They would be solved—for good or ill—by the autocrat. But we are living in a democracy. Problems in peacetime in our nation are solved by the democratic processes of group discussion, co-operative thinking, and legislative experimentation by the representatives of the people.

Naturally, it is not to be expected that school pupils, of either elementary- or high-school levels, can *solve* the problems of our nation in the new air age into which we have entered. That will have to be done through collective thinking by our citizens and continuous and extensive experimentation. To attack any problem successfully, however, requires an intelligent understanding of the framework of basic facts, ideas, and points of view in which the problem is embedded. The schools can and should make an important contribution to the development in their pupils of the elements of this framework which should be the possession of every citizen in a democracy.

This framework of thinking for attacking the problems of the air age is derived from facts and concepts in many fields. It has elements drawn from mathematics, history, geography, science, politics, and economics. These areas of study are already represented in our elementary- and high-school curriculums. It follows, therefore, that sound education for the air age is only partially a matter of introducing new subjects into the curriculum. It is also a matter

of reorganizing certain aspects of existing subjects in terms of new emphases and new illustrative materials.

### THE PURPOSES OF AVIATION EDUCATION IN SCHOOLS

The Committee believes that the views expressed in the preceding paragraphs imply a number of purposes for aviation education in the public schools, and that these purposes may serve as a basis for the organization of aviation education in schools.

As a basis for its proposals, therefore, the Committee suggests these aims for aviation education in the public schools of Illinois.

1. *It should assist pupils to meet the minimum requirements of citizenship.* This is a statement of the minimum requirements of general education, for there are concepts, attitudes, and information derived from the broad field of aviation which should be common to all people. Every pupil should become aware of the effects of civil and military aviation upon the interrelationships between the pupil and the world in which he lives.

The acceptance of this purpose for the elementary grades is unquestioned, but it is equally valid for the secondary schools. The same development of general understandings is an important part of all subject fields in the high school. There are, for example:

Geographical concepts, such as the concepts of direction as shown by the polar map, concepts of geographical measurement in degrees, in altitude, and in travel hours; the effects of topography on air transportation.

Social concepts and attitudes, such as the necessity for the improvement of international and inter-racial relations; the social aspects of health and disease transmission; probable changes in the location and nature of social groups.

Economic concepts, such as those involved in the air transportation industry; in possible changes in the distribution of goods and services, in the consumption of the products and services of aviation.

Political concepts (aeropolitics), such as the decreasing importance of natural barriers between countries; national and international control of air routes and air traffic.

Science concepts, such as the effects of altitude upon the human organism; the general principles of flight.

It should be noted that the above list makes no pretense of being exhaustive, and that such topics as the ones suggested might be used at several grade levels.

2. *It should provide additional pupil experiences which may be expected to be useful to many people.* In order to achieve the purposes of general education beyond the minimum requirements for effective citizenship, many pupils at various school levels will find useful more extensive and detailed study of

aviation and its effects upon human affairs. In achieving these purposes, it is necessary to provide additional experiences which may be chosen by pupils with the guidance of teachers. At all school levels these additional experiences may be provided by co-operatively developed pupil projects and by individualized assignments. In addition to making such provisions, high schools will find elective courses necessary in achieving this purpose. The Committee believes that several of the elective courses for high-school pupils should include a limited amount of flight experience as laboratory work.

3. *It should provide minimum preparation for safe personal piloting* (leading to the private pilot's license), if (a) adequate local facilities and public support are available, and (b) if the provision of such training does not seriously limit offering a laboratory type of flight experience to a large number of pupils. This purpose is obviously appropriate only for the upper years of high school.

4. *It should provide for the special needs of high-school boys who seem likely to be inducted into the military air forces.* Even though the period of most rapid expansion of the air forces in the present war is past, there seem to be military reasons for continued emphasis upon such a specialized purpose for aviation education in secondary schools. The air forces will continue to demand personnel as long as the war lasts. It seems possible that there will be a period during which a considerable military establishment will be maintained after the war, with approximately one third of the personnel in the air forces. It is evident that the weight given to this aim should depend upon the continued needs of the air forces.

5. *It should provide for the vocational competence of some high school students,* if there is an evident opportunity for their employment. This aim is discussed further in the part of the report entitled, "The Industrial Education Program in Aviation."

### PROGRAMS FOR ENRICHMENT OF PRESENT COURSES IN ELEMENTARY AND SECONDARY SCHOOLS

In the previous sections of this report, emphasis is laid on the fact that aviation education must not be thought of as consisting only of special courses in aeronautics. As was so effectively stated by Elmer Davis, the invention of the airplane "has changed human life more than anything else since the invention of fire . . . the result (of this invention) was the transformation of human life from a two-dimensional to a three-dimensional activity, several thousand years before human nature was ready for the additional responsibilities thus entailed."[1]

If one adds to the above quotation one from John Dewey, certain conclusions with reference to the curriculum in the air age become inescapable.

[1] ***Handbook on Education and the War,*** **p. 78. Washington, D. C.: Superintendent of Documents.**

Dewey says, "The purpose of education has always been to everyone in essence the same—to give the young the things they need in order to develop in an orderly, sequential way into members of society . . . Any education is in its forms and methods an outgrowth of the needs of the society in which it exists."[2]

If our world has undergone so great a transformation through the development of the airplane as Davis indicates, then it seems obvious that the curriculum which is "an outgrowth of the needs of the society" should undergo corresponding changes. These changes should be carried out in practically every subject in the curriculum. But the methods by which they may be introduced and made effective are not followed in too many of our schools. There is a conservatism with respect to the public school curriculum which tends to resist change. This conservatism is by no means entirely bad. With the responsibility of influencing to an extraordinary degree the thinking of our future citizens, the schools do well not to be led immediately into new paths until some sound thinking and experimenting has been done, and until the need for change has become clear and inescapable.

The need of curriculum changes to take into account the impact of aviation on our modern world has now reached this state of clearness. It is time to abandon the conservatism which resists change, and to overcome an inertia which will seriously interfere with the effective performance of the duty of our schools to "give the young the things they need in order to develop . . . into members of society."

What has been said above does not argue for the introduction of a series of new courses into the curriculum of the schools, although some such courses are appropriate on the secondary level. The change in human living which has made it into a three-dimensional rather than a two-dimensional activity permeates every area of life. Since the curriculum consists of the study of these various areas, it follows that aviation education should change emphases, ideas, and materials of instruction in practically every field of study which the school child pursues.

Some suggestions with reference to these new emphases, ideas, and materials of instruction are given below. It is recognized that these suggestions are sketchy and incomplete. They must be implemented by serious study conducted by teachers, administrators, and specialists, working co-operatively. It seems wise, therefore, to indicate briefly some suggestions for carrying on this implementation.

It has been shown both by research and experience that the best way to overcome inertia in making curriculum changes is to have them worked out by teachers themselves rather than by experts. When a series of suggestions for change are worked out by experts, and then merely handed by the school administrators to teachers, the new ideas are likely to be followed grudgingly, if

[2] Dewey, John. "Why Have Progressive Schools?" *Current History*, July, 1933.

at all. It is, therefore, proposed that in school systems and in individual schools, committees of teachers be organized in various curriculum areas to study the changes which should be recommended and to give specific help in making them effective. This help should consist of suggestions of aviation emphases paralleling accepted topics and units for each area of study. There should also be included the names of useful books and pamphlets and lists of visual materials. If each teacher could have such a series of curriculum suggestions, made in part by himself as a committee member, or by his colleagues, the results in introducing aviation education into our schools would be prompt and effective.

The ways in which the program outlined in this report should be carried out will vary in individual school situations. Most schools already have in operation a plan for teachers' meetings. Usually, the actual time spent in the meetings in discussing common problems is supplemented by outside study by teacher committees, which from time to time present their findings in mimeographed form to all the teachers. In this time of crisis and of special emphasis on the problem of introducing aviation education into the schools, it would seem appropriate to devote a year's meetings to the development of aviation education materials and to the consideration by teacher committees of ways and means of curriculum development in the field.

In the same connection, patrons of the school district can be interested in discussions of the effects of the airplane upon the world and upon education. Particular community organizations should assist, such as public-relations committees, parent-teacher organizations, lay advisory groups, fathers' or mothers' clubs, or school-community councils. Special community meetings or entertainments at the high school might also afford a favorable opportunity for the presentation of such information. If the school patrons are wholeheartedly in support of aviation education, there should be little friction developed by an aviation education program in a local school situation.

To carry the public relations a step further, the school administrator might establish an adult educational council to formulate a program of study that would meet the interests of citizens in the school district. There are many areas that come to mind in thinking of possible developments in this field: local airport planning, flight training, a reading group to follow trends in aviation, ground-school work, the utilization of the airplane in certain occupations, and other problems of a similar nature. It is time to recognize that the school is no longer a cloistered institution separate and apart from the rest of society. In a particular school situation then, if citizens desire knowledge in aviation, it seems plausible to suppose that adult courses would be favorably received, because the airplane has a magnetic appeal for a large number of people.

As has already been stated, it is not the purpose of this report to make a complete survey of the aviation emphases which should be included in our school curriculum. That is a task for long study by teacher committees. There

are given below, however, some suggestions in the different areas, of the kind of materials about aviation which might be included to prepare youth for the air age.

1. *Science.* — In the field of science, many opportunities will be found to correlate aviation with the topics now included in science courses. Our knowledge of weather and climate has been greatly modified by recent research. In the future, even greater emphasis will be given to this area of study, both by individual scholars and by government agencies, as the use of airplanes becomes more general. Weather stations will have to be located in many now uninhabited places on the earth in order to give information to the flying public about flying weather and approaching storms. Information about weather should be woven into science courses in both elementary and secondary schools.

Many of the scientific data on which the theory of flight is based can be reduced to very simple terms for study in elementary schools. A more thorough approach can be made in high-school classes, where the theory of flight can be incorporated into the regular course in physics. Simple experiments and apparatus can be devised for use on both school levels.

Courses in health can use some data about the effect of high altitude flying on the human organism. Knowledge of the high standards of health for pilots can be utilized to stimulate study and practice of hygienic personal habits. The fact that all nations are now within a few hours of each other in flying time will emphasize the fact that the health of the whole world, not just that of our own community, is of serious concern to everybody. It can be emphasized that the airplane may be both a help and a hindrance to the health of the world. On the one hand, it may spread infection through carrying insects or infected passengers; on the other, it can take doctors, nurses, or medicines and blood plasma to stricken areas.

The use of electricity and radio equipment in aviation will lead to study and experimentation with simple apparatus in the elementary school, and to more thorough pursuit of the subject in the high-school science courses.

2. *Mathematics.* — The fact that interest is a very important factor in learning mathematics has been well demonstrated in the training of men and women for the Air Corps. When cadets and other air personnel saw that it was necessary for them to acquire certain mathematical concepts and skills, they showed an immediate and powerful interest in mathematical problem solving in areas related to flying.

It is suggested that elementary and secondary teachers collect and improvise problems that deal with the facts of aviation. Topics such as the following lend themselves to the development of mathematical problems: (a) distances and flying time between important points; (b) great-circle directions; (c) loads, costs, and other factors of air transportation compared with other methods of transportation; (d) problems in the science of aeronautics, particularly in

high schools, in connection with problems of power, lift, weight, drag, wing loading, stalling speeds, and the like.

3. *Language Arts.* — In this field, the main emphases are on reading, creative writing, and the appreciation of literature.

One learns any skill by practice in it. To stimulate wide reading has been one of the chief problèms of the reading and literature programs in both the elementary and the secondary schools. Today youth are deeply interested in the airplane, and will eagerly read stories and factual materials dealing with the machines themselves and with their effects on modern ways of life.

In the same way, original compositions, both oral and written, can be made a more interesting and vivid experience if topics dealing with aeronautics are used as composition subjects.

Illustrative topics for study by teachers who are preparing curriculum suggestions in the language arts field are (a) history of the aviation industry; (b) history of pioneer aviators; (c) heroes of the development of the science of aeronautics. Topics in aviation may be used for oral and written compositions and for the development of vocabulary with special reference to aviation words.

4. *Social Studies.* — The social studies offer, perhaps, the most important and varied opportunities for the integration of aviation education with the previously accepted subject matter of the school curriculum. The ramifications of the social studies into the fields of geography, history, economics, political science, sociology, and civics make it impossible to neglect so revolutionary an invention as the airplane. The effect of the airplane on the studies of relationships and problems which make up the social studies curriculum can be taught in connection with topics such as these: (a) civil air regulations as a form of governmental control over activities of private citizens; (b) global geography; (c) modern methods of transportation and communication which inevitably bring nations into a more intimate relation with each other; (d) town and city planning with respect to the location of airports; (e) implications for future world security of developments in military aviation; (f) the effect of air transportation on the development of backward peoples in the world.

5. *Special Subjects.* — Teachers of fine and industrial arts, music, and physical education may enrich the curriculums in these subjects by co-operative projects with the teachers of other subjects. The unit project idea will make easy such effective correlations as the following: (a) the industrial arts teacher may help to teach global geography by promoting a project on the making of globes; (b) the physical education teacher may lay stress on the high standards of physical efficiency required by military and civilian flying and thus promote interest on the part of the pupils in better health ideals and practices; (c) the development of streamlining in plane design may be studied

in fine arts classes as a sample of the union of beauty and utility in machines; (d) children may be stimulated to produce both words and music for their own songs. Like all other creative work, that in music develops from the most vivid experiences of man; poetry and music to accompany it will grow from the study of man's new experiences in flight.

### AVIATION EDUCATION IN THE ELEMENTARY SCHOOLS

The purpose of introducing material on aviation into elementary schools is not vocational. The elementary school has little or no place for vocational training. As the school of all the children of all the people, its task is to give them, as far as possible, the basic information and points of view which are the necessary possessions of all citizens in a democracy. The purposes underlying the use of materials concerning aviation in all the subject matter areas of the elementary curriculum are: (a) to meet the interests of the elementary-school child in a growing field of human achievement; (b) to use that interest as a motivating and enriching force in pursuing the accepted areas of elementary-school education; (c) to utilize that interest as a means of educating the future citizens in a world which has been vitally altered by aviation.

It may sometimes be desirable to include some short units devoted entirely to a topic in the field of aviation, but this should in no sense constitute the total education of elementary-school pupils in the field of aviation. The introduction of aviation facts and concepts into all subjects in the curriculum will constitute the chief education of elementary-school children in aviation.

### COURSES IN AERONAUTICAL SCIENCE

In both small and large high schools regular courses in aviation should be offered. The general course in the science of aeronautics should include the units of aerodynamics, principles of aircraft structure, aircraft engines, civil air regulations, meteorology, air navigation, and communications. A more detailed discussion of these units is given under the topic — *Course of Study in Aeronautical Science*. In the large school systems specialized half-year courses in meteorology and navigation might follow the general course in the science of aeronautics. The courses have been taught effectively and they have proved to be popular offerings for students who are interested in expanding their knowledge in these areas.

1. *Purposes of the Science Course in Aeronautics.* — The general course in science of aeronautics is taught more frequently than any other course in aviation because there are well organized materials available and because instructors have become acquainted with them. It can be offered in most schools and is the course that best meets the science objectives of aviation education.

The purposes of high-school courses in the science of aeronautics may be summarized as follows: (a) to prepare better those boys who may be entering the air branches of the military services (The course content not only meets the objectives of general education, but it also meets the needs of boys who

enter the Air Corps.); (b) to teach the principles of science and mathematics which are applicable to the field of aviation; (c) to prepare pupils to participate in civic affairs which are affected by aviation (Showing the implications of the airplane to civic affairs is primarily a matter of teaching emphasis.); (d) to utilize the interests of pupils in aviation as a motivating factor in learning; (e) to lay a background of understanding which will lead to eventual personal participation in aviation.

2. *Administrative Arrangements.* — It seems apparent to the Committee that prerequisites for the work should be the same for all high schools; that the courses should be available to all students who meet minimum requirements. In other words, it is thought that intelligence test scores, stringent course prerequisites, and other rigid standards might tend to defeat the purposes of aviation courses as general education. More specifically, the Committee recommends that the course in the science of aeronautics be available to those *boys* and *girls* in the junior and senior years of high school, who have completed the minimum requirement of one year of science and one year of mathematics.

The next problem is how to place the course in the school curriculum. It is desirable that the course in aeronautics should be assigned a place in the daily school program which will attract prospective students, and that the hour assigned should facilitate field trips, laboratory work, and flight experience.

The small school has the additional problem of organizing the daily program so that the science of aeronautics can be included in the curriculum. In descending order of preference, alternative programs for small high schools are: (a) offer a science of aeronautics course each year if there is sufficient demand for the subject; (b) alternate the science of aeronautics with the physical science that is given in the junior or senior year if the enrollment will not justify offering the course each year; (c) make arrangements to transport aeronautics students to a neighboring school where a regularly qualified teacher of aeronautics is available; (d) offer a course less than one year in length; (e) introduce aviation units into the physics course; (f) offer the science of aeronautics by correspondence at board expense; and (g) offer aviation work as an extracurriculum activity.

3. *Teaching Materials.* — Several textbooks have been written for the course in aeronautics. School officials should examine them carefully and adopt those which meet the needs of their own school situations. A good textbook in the science of aeronautics should do more than cover the technical phases of aviation. It should so develop the content of the course that high-school students will see the relationship that exists between scientific principles in aviation and the scientific principles found in other areas of our physical world. If a text is not desired, the essential units in the science of aeronautics can be covered through the use of other source materials that can now be found on the market.

Source and supplementary reading materials are more plentiful in aviation than in many other areas. Current publications should be constantly examined for aviation materials. Films, film strips, and other visual aids constitute excellent teaching devices. A detailed description of such materials may be found in the bibliography of this publication.

Beyond the scope of printed matter, a well stocked physics laboratory includes equipment that can be used in aviation instruction. Additional specific items may be purchased or built in the industrial arts shop. Wind tunnels, flying model planes, and gliders, for example, have been successfully completed in various high-school industrial arts departments.[3]

Schools may now obtain obsolete airplanes or airplane parts through arrangements with the armed services. These may be used for laboratory or ground school study. Many of the books listed in the bibliography also offer additional suggestions on laboratory equipment.

4. *Library.* — In aviation education, as in the other areas of learning, the library is the pivot around which the rest of the school rotates. The librarian seeks constantly to stimulate reading by pupils. There are many excellent reading materials about aviation which are eagerly read by students when they are made available. It is suggested, therefore, that school librarians consider adoption of the following practices: (a) the purchase of an adequate collection of books and magazines on aviation; (b) encouragement of pupils to bring aviation clippings to school to be displayed upon a bulletin board and later to be placed in a file for reference; (c) suggestion to the public libraries of appropriate aviation materials for various levels of reading ability; (d) making of aviation materials in the high-school library available to the general public; (e) supplementation of the school library by procuring materials on aviation from the state library and other governmental sources; (f) provision of a shelf to be used for the display of aviation publications; and (g) display of book covers on aviation in appropriate places in the business district.

5. *Suggested Methods for Teaching the Science of Aeronautics.* — Much remains to be done in the development of teaching methods in aeronautics. A few general suggestions may be made: (a) adjust the course to meet the needs, interests, and abilities of the pupils; (b) provide appropriate field trips in connection with the classroom teaching; (c) make the course functional by applying the aviation principles to actual situations in everyday life; (d) utilize available laboratory equipment, film strips, films, and other visual aid materials; (e) use current materials, such as aviation periodicals, in keeping the course up to date. (See bibliography.)

In many classes, a few pupils will be better informed than the teacher on certain practical phases of aviation. Such pupils should be encouraged to lead the discussion and to contribute the knowledge they have acquired. Students

[3] Wilber and Neuthardt. *Aeronautics in the Industrial Arts Program.* Gives many excellent examples of how laboratory equipment can be constructed.

should be encouraged to explore as many areas of knowledge as time will permit in a one-year course. The teacher should, of course, guide and direct their study so that what is learned is sequential and is organized around a general pattern of thought.

6. *Characteristics of a Good Instructor.* — It is believed that teachers who are interested in aviation make the better instructors. A science or mathematics background is also desirable, although many excellent instructors have had preparation in industrial arts or in other fields. Given an interest in aviation and the necessary academic background, aeronautics teachers will improve themselves beyond minimum requirements by private pilot training, flight experience, special courses in aviation, or teacher education courses which emphasize aviation.

7. *Course of Study in Aeronautical Science.* — The course may well be introduced by a brief history of aviation, discussion of global concepts of geography, and consideration of the effects of the airplane on society. These topics may be used to orient pupils to the subject matter that is to follow.

The units studied, and the relative emphasis given each, depend upon many factors. Under ordinary conditions the principal units of the course are airplane structures, aerodynamics, power plants, meteorology, air navigation, communications, and civil air regulations. The teaching of radio code and aircraft identification have been attempted in some schools, but it is recommended that these topics be de-emphasized, or perhaps omitted from the general one-year course in science of aeronautics.

Each of the general texts listed in the bibliography presents the various parts of the course in the sequence and emphases thought best by the authors. The resourceful teacher will use texts and other printed materials only as they contribute to the learning of his individual students and as they serve the particular purposes for which the course is being taught.

8. *Laboratory Work in Aeronautics.* — Laboratory work in aeronautics can be very useful in meeting the objectives of the course, both those pertaining to the general educational aims and to the technical goals.

Laboratory work provides a means of taking care of individual differences, of learning scientific methods, of economy in learning, and of motivating the work in the course. These four points should serve as criteria for the teacher in selecting experiments to be performed by his group.

Some of the experiments which may be performed in a course in aeronautics are duplications of those done in the physics laboratory. As an example, composition and resolution of forces should be understood in connection with aerodynamics. The results of the experiments can then be given added meaning as their applications are illustrated repeatedly throughout the course.

An experiment which will instruct pupils in scientific method can be done in attempting to demonstrate the lift and drag formulas. Pupils may build a

wind tunnel according to the plans given in various books and pamphlets available. Then the question may be raised with them: How can we test the accuracy of the formula for lift. They should be led to making statements about testing one variable at a time while the others are kept constant. Thus lift depends first of all upon the type of airfoil. Have pupils make various types of airfoils of the same area. Lift depends upon angle of attack. The various types of airfoils may be tested at various angles of attack in the wind tunnel and lift determined. Lift depends upon the density of the air. This is the most difficult part of the formula to test, but with careful work, differences in lift can be detected on days of low and high barometric pressure. Lift varies with the square of the velocity of the air. Velocity can be measured with an air-speed indicator if one is available, or with an anemometer. Efficiency of various propeller types may also be measured by making two or more to use on the fan for producing the air flow. Lift depends upon the area of the airfoil. The same type of airfoil may be produced in two or more different sizes.

An experiment such as the one just described should provide valuable instruction in scientific method for the pupils involved. It can be related to other areas of the curriculum. Relations to physics are obvious. The use of mathematical formulas are also involved. Graphs of the lift and drag coefficients of various types of airfoils can be made. The connection between such experiments and the development of flight may be pointed out. Co-operation between the industrial arts department and the aeronautics science teacher and pupils is necessary in building the equipment.

Demonstrations of Bernoulli's principle may be made with a ping-pong ball. Then the pupils should be asked to form their own hypothesis as to why the ball stays in the column of air. The various hypotheses should be examined

**Students of Polytechnical High School of Fort Worth, Texas, are keenly interested today in aviation education.**

and methods of validating them or rejecting them worked out. An excellent learning situation will be had when such procedure is followed.

The teacher should analyze the work his class is doing and know just what understandings he wishes his pupils to get. Then he should raise the question: what are the basic concepts necessary for these understandings? To illustrate this process; in dealing with the measurement of air pressure in meteorology, the millibar is used. In order to understand the millibar it is necessary for the pupil to understand what is meant by a dyne. This in turn requires an understanding of force, mass, and acceleration. After making this analysis, the teacher may decide that the best method of getting the desired understanding is through the use of appropriate experiments. A familiarity with the available literature is essential here. Excellent sources of experiments and demonstrations may be found in aeronautics or physics laboratory manuals and in the teachers' manuals which accompany texts on aeronautics.

It is impossible to list all the experiments which could well be considered. Some general areas, however, have been illustrated, such as aerodynamics, appropriate experiments with wind tunnels, composition and resolution of forces, and Bernoulli's principle. Study of airplane structures leads to experiments with strength of materials, tension, torsion, shear, and elasticity.

Appropriate experiments in meteorology include those on laws of gases, heat, and actual weather observations with instruments where they may be obtained. Most laboratories have psychrometers available, for instance, for obtaining relative humidity. If such an instrument is not available, dew point may be determined by putting a thermometer in a beaker of water and letting a fan blow on the surface, or small amounts of cracked ice may be added and the temperature reduced gradually.

In navigation, the type of laboratory work is somewhat different from that usually considered to be laboratory work, but a floating globe may be used for getting great-circle concepts, flights may be plotted on actual maps with data supplied by the instructor, and such things as drift sights may be improvised with two circular protractors put in the bottom of a wagon or cart with movable castors or wheels.

In general, the instructor should remember that the laboratory part of his course can be extremely worth while in attaining his objectives. He should keep in mind that a few well-chosen experiments, which meet the criteria outlined earlier, will be of far greater value than a large number hastily done.

### FLIGHT EXPERIENCE AS A LABORATORY EXERCISE

The Committee believes that a very effective part of the laboratory work of high-school students enrolled in aeronautics courses should be actual flight experience—four hours of flying in a trainer-type airplane equipped with dual controls. This recommendation is made for courses in the science of aero-

nautics and for courses in industrial arts which are devoted to various phases of aeronautics. The purpose of flight experience as a laboratory exercise should be to make all the rest of the classwork more meaningful, rather than to teach students to fly.

Regular courses in vocational aeronautics may have a similar amount of flight as laboratory experience or may offer the more extensive training leading to the private pilot's license. The sub-committee on large high schools also approved full pilot training for students of the science of aeronautics, so long as it did not interfere with giving four hours of flight experience as laboratory work to all students eligible for it.

The discussion which follows concerns flight experience as laboratory work in connection with courses in the science of aeronautics and aeronautics as taught in industrial arts courses on the senior high-school or post-high-school levels.

There are two reasons for suggesting four hours of flying time. It is believed that any less time would be uneconomical in terms of learning value. More than four hours might give the more skillful students an unwarranted confidence in their ability to fly. If any schools wish to give more than four hours, they are urged to carry their periods of instruction through the minimum course of thirty-five hours required for a private pilot's license under the Civil Air Regulations. Flight instruction in excess of four hours but less than the minimum required for the private pilot license is not recommended for high-school students.

The content of the proposed laboratory experience in flight differs somewhat from the content prescribed by the Civil Aeronautics Administration for the first four hours of a program for training pilots. The emphasis is placed upon demonstrations of principles of the science of flight, rather than upon the development of skill by the student. The student does less actual handling of the plane in the laboratory flight experience, and the time thus saved is devoted by the instructor to demonstrations of air maneuvers which, in training pilots, would come after the first four hours. It is recognized that there will be an educational problem in developing flight instructors who understand that their primary function is to teach science rather than to develop piloting skills.

1. *Liability in Connection With Flight Instruction.*—It is recognized that questions of possible liability for accidents must be answered before flight experience can be adopted generally as a part of the educational program. This is not a problem of great difficulty in Illinois.

It is clear that, under a contract of the suggested type, no responsibility for negligence on the part of a certificated flight instructor or flight contractor could be passed on to a school district, to a Board of Educatoin, or to teachers or administrators in the schools.

The flight instructor is personally liable for his own negligence, and the

flight contractor is also liable, on grounds of agency, for the negligence of the flight instructor. The flight school operated by the contractor is a private enterprise conducted for profit and is, therefore, not given the legal immunity accorded in relation to the governmental activities of school districts or school boards. This is a liability which has always been assumed by flight instructors and flight contractors in all flight instruction given to civilians, and the flight instructors, flight contractors, and civilian students have all been protected by insurance. The contractual provisions which have been suggested are similar to those which have been required of the flight contractors and flight instructors in their regular programs for civilians.

Every teacher, like all other persons, is ordinarily liable for the damage caused by his own negligence to a person injured because of that negligence, but no member of the teaching or administrative staff of the high school would be a flight instructor under the system where the school board contracts with a certificated flight school to give the flight experience. Under this system, the flight instructor would be an employee of the flight contractor. Should a high school arrange for a member of its own teaching staff to give flight instruction, provisions should be made to obtain insurance to cover any personal liability he might incur.

It is suggested that school officials consider the advisability of approving all airplanes and flight instructors used in the aeronautics programs of the schools. Each high-school principal should satisfy himself, his superintendent, and the local Board of Education that proper facilities and personnel are available for the proposed school program. It is strongly recommended that the written consent of parents of the students be obtained before the students fly as part of their school work.

2. *The Contract Between the School District and the Flight Operator.*— The arrangements for flight experience should be the subject of a written contract entered into by the Board of Education or other legal representative of the school district and the flight operator (hereinafter called the contractor) who will provide the flight instruction to students. No effort is made in these recommendations to define the exact wording of the proposed contract, but the principal terms thought to be desirable are outlined in general. Other provisions should be added to meet the requirements of local situations. These preliminary statements of policy should not be regarded as proved and tested; they are only the concensus of opinion of the Committee responsible for this report.

It is suggested that the county attorney, or other public legal representative of the Board of Education prepare the contract according to the forms established in the state of Illinois. The contract should be signed by the president and secretary of the Board of Education, as required by Illinois law, and spread on the minutes of the Board.

*a. Purposes of Flight Instruction.* — It is thought to be appropriate that the contract should state that the principal purpose of the flight instruction is to provide laboratory exercises to demonstrate principles of aeronautical science as they have been learned in the classrooms of the local high school. The contractor and the flight instructors employed by him should be required by the contract to confer with and receive advice from the educational authorities employed by the Board of Education in order that the concepts of science may be demonstrated in flight conceived as a laboratory exercise. Development of skills in the manipulation of an airplane is secondary. Under no circumstances should the student be led to believe that his instructor is taking him as far as possible, during his four hours in the air, toward learning to fly. Perfection in the execution of any flight maneuver is not the primary purpose of the flight experience.

*b. Services to Be Performed.* — The contract should provide for four hours of flight instruction in lessons of approximately thirty minutes of air time for each student certified as eligible by the Board of Education. Not more than one flight lesson should be given in any one day to a student, except under unusual conditions and after agreement with the high-school authorities. The contractor should agree to give ground instruction at the airport in ratio of fifteen minutes of ground for each thirty minutes of air time. This ground instruction should include starting procedure, swinging of propeller, warming up engine, stopping engine, and line inspection of aircraft.

*c. Flight School.* — The contractor should be required to maintain an approved flight school in accord with the provisions of the Civil Air Regulations.

All flight instruction should be given by properly licensed flight instructors in accordance with the Civil Air Regulations pertaining to approved flight schools.

The contractor should be responsible for the establishment of a definite flight pattern for students at the airport. This pattern should include take-offs, elementary flight maneuvers and landings, and should be adhered to at all times. The flight instructors should log the flight experience of each student after each flight in log-books to be furnished by the Board of Education. The log-books should be signed by the student immediately after each flight, but in no case should they be signed in blank.

*d. Maintenance of Personnel and Equipment.* — The contractor should be required to provide flight instructors in proper ratio to the number of students to be instructed. For the purpose of computing the number of flight instructors necessary, eighty hours should be the maximum time flown by any one instructor in any thirty-day period.

The contractor should provide airplanes of not less than fifty horsepower, equipped with fully operating dual controls, brakes, sensitive altimeters, properly operating compasses, and other standard equipment required by the Civil Air Regulations. If tandem-seating aircraft are used, they should be equipped

with a small mirror to allow the instructor to observe the student while in flight. If an electric interphone communications system is not used, a speaking tube should be made available so that the instructor may explain maneuvers during flight. The instructor should make certain that this equipment enables the student to hear satisfactorily while in flight.

The contractor should provide parachutes, maintained in accordance with the provisions of the Civil Air Regulations, for both student and instructor. These should be worn on all flights.

There should be at least a daily inspection of each aircraft used for flight instruction, and the results of the inspections recorded and signed by the contractor or a person responsible to him. Each student should make at least one such inspection during his flight experience and affix his signature to the proper form.

*e. Ground Instruction to Classes at the Airport.* — The contract should provide that preliminary ground instruction shall be given at the airport to all flight students as a group before any flight instruction is undertaken. This should consist of simple explanations of controls, instruments, throttle, brakes, fuel system, safety belts, and location and use of fire extinguisher and first aid kit. Warnings should be given concerning propeller danger, running engine with empty cockpit, local traffic rules, and use and care of parachutes. Flight instruction signals should also be taught at this time.

*f. Flight-Instruction Curriculum* — The contract should provide for teaching the following flight maneuvers in the sequence indicated below. Maneuvers indicated by asterisks are not in the normal flight instruction sequence but they are to be demonstrated by the instructor where indicated in this sequence. All flight experience should emphasize the demonstration of scientific principles, rather than the perfection of manipulation of the airplane.

| *Approximate Flight Time* | *Lesson* | |
|---|---|---|
| 0-:30 | 1 | The following maneuvers will be both demonstrated and practiced: Taxiing, Effects of Controls; Straight and Level, Turns; Effects of Controls, Taxiing. |
| :30-1:00 | 2 | Taxiing, Straight and Level, Turns, Co-ordination Exercises*. |
| 1:00-1:30 | 3 | Taxiing, Straight and Level, Turns, Co-ordination Exercise, Confidence Maneuvers,* Climbs and Turns,* Glides and Turns,* Taxiing. |
| 1:30-2:00 | 4 | Taxiing, Climbs and Turns, Straight and Level, Co-ordination Exercise, Glides and Turns, Taxiing. |
| 2:00-2:30 | 5 | Taxiing, Take-offs,* Climbs and Turns, Co-ordination Exercise, Stalls in Turns, etc.,* Glides |

| | | |
|---|---|---|
| | | and turns, Approach 90°, Landing,* Taxiing. Considerable ground instruction should be given on stalls and the beginning of spins as they apply to turns, climbs, glides, recoveries, etc. |
| 2:30-3:00 | 6 | Taxiing, Take-offs, Climbs and Turns, Co-ordination Exercise, Stalls—stress accidental,* S-Turns,* Glides and Turns, Approach 90°, Landing,* Taxiing. |
| 3:00-3:30 | 7 | Taxiing, Take-offs, Climbs and Turns, S-Turns, Co-ordination Climbing and Gliding Exercise,* Glides and Turns, Approach 90°, Landing,* Taxiing, Spins—accidental and intentional.* Spin demonstrations should be given in either Lesson 7 or 8, dependent upon conditions. |
| 3:30-4:00 | 8 | Taxiing, Take-offs, Climbs and Turns, S-Turns, Co-ordination Climbing and Gliding Exercise, Glides and Turns, Approach 180°,* Landings, Taxiing. |

*g. Insurance.* — The contractor should provide public liability insurance protecting the contractor and his flight instructor, the school district and its Board of Education, and the student, in the amount of $50,000::100,000, and property-damage insurance covering all these parties to the extent of $5,000. The contractor should also provide insurance for the student in the amount of $3,000 in case of death and $500 for hospital and medical expenses in case of injury.

*h. Transportation of Students.* — It is recommended that the contract provide that the Board of Education assume responsibility for transportation of aeronautics students to and from the airport.

*i. Financing of Flight Experience.* — The contract should provide for the payment of the flight contractor by the Board of Education of a fee agreed upon between the parties. This fee should be computed on a basis of hours of actual flight time received by the students. At present, the cost of flight instruction of the recommended type is approximately $10 per flight hour. This price may be lower in the future. All insurance costs should be paid by the contractor, and should be considered part of the cost of the flight instruction. It is strongly recommended that the school pay a satisfactory rate and place itself in a position to demand high-quality instruction at the airport. This will do much to insure satisfactory and safe instruction.

*j. Records and Reports.* — All records regarding CAA inspections of personnel and equipment which are necessary for the maintenance of an approved flight school should be made available to the School Board or its representatives at their request. All records kept by either the contractor or the school concerning students who receive flight experience should be available

to both parties to the contract. The contractor should have the right to discontinue the flight experience of any student for any sufficient cause, after consultation with the school authorities. The contractor should furnish a weekly report to the school on the progress of each flight student and should co-operate with the school authorities in preparing and administering any tests or examinations to be taken by the flight students at the completion of their four hours in the air.

*k. Cancellation of Contract.* — It is suggested that provision be made in the contract for its cancellation upon thirty days written notice at the option of either party.

### PILOT TRAINING

Pilot training for private flying may be taught in a manner which will serve the purposes of general education, as well as meet the objectives in connection with vocational training in aeronautics. Pilot training should follow approved patterns already developed by the Civil Aeronautics Administration for primary flying schools, and should not be terminated, except in cases of student failure, short of the thirty-five to fifty-hour program essential for competence. If a choice must be made between the laboratory experience program and the pilot training program the Committee recommends flight experience rather than pilot training on the principle of service to the greatest number, so far as science of aeronautics students and those in industrial arts courses are concerned.

### THE INDUSTRIAL EDUCATION PROGRAM IN AVIATION

Since education deals with the total of all our experiences, the interests of pupils tend to be general in their objectives until they have made a definite choice of their future vocations.

The secondary-school program must recognize both general and vocational educational needs, with the greater emphasis given to general education in the early years of the secondary school and increasing emphasis to more specialized vocational training in the later years, but with no sharp break or division between the two. A student should explore the various possibilities in the school programs to discover the extent and character of his talents and to define his interests.

Industrial education in the school program is thus divided into two general phases—the industrial arts or general education phase and the vocational

1. *Industrial Arts.* — In this scientific age, it is imperative that every person have an insight into and an appreciation of modern industry and industrial life. Although many subjects of the secondary-school curriculum should play their part in giving prospective citizens a better understanding of the significance of industry in social and economic life, the main burden of providing experiences in industrial processes and imparting knowledge of industrial materials, products, and problems must be carried by the industrial courses

if youth is to be prepared adequately to deal with modern life. Just as physics and chemistry represent the world of science in the curriculum, industrial arts represent the world of industry.

The industrial arts courses are an excellent medium for providing exploratory and try-out experiences which will enable the student to discover his interests, aptitudes, and capacities, thereby enabling him to make a more intelligent choice of his future life work.

Since the field of aviation is a vital and significant factor in our everyday living, the various industrial arts offerings must include applications to aviation.

In those schools which are organized on the general shop basis, the Committee favors the substitution of the general aviation shop for the usual type of general shop if the teacher is qualified to handle the different aspects of aviation.

Where the junior high-school organization does not exist, the Committee recommends that the general aviation shop be provided in the last years of the elementary schools.

In senior high schools equipped with unit shops, it is suggested that the industrial arts courses be centered around aviation construction and repair, if the teachers are qualified to give adequate instruction.

It is also suggested that in the established shop courses in woodwork, sheet metal, electricity, machine shop, auto mechanics, and mechanical drawing the related material taught should include information concerning the aviation industry—transportation, manufacture, and related service occupations. Projects which involve the construction of parts of the airplane should also be included.

All industrial arts courses should attempt to develop in each student an appreciation of good materials and workmanship, to instill desirable traits and attitudes, to produce intelligent consumer points of view, and to cultivate some skills in the use of common tools. To accomplish all of these aims satisfactorily in the air age, much use should be made of subject matter from the field of aeronautics.

When the shop courses are built around aviation, these courses should be made a prerequisite to the private-pilot license flying course. For those students who are definitely planning to become commercial pilots or flight engineers, such flight instruction should be considered vocational in nature.

The industrial arts classes provide opportunities for concrete demonstrations of various aerodynamic principles. Pupils can construct aviation projects: model airplanes, small airports, even small airplanes that actually fly. Experimental equipment can be constructed to show pressure in a venturi tube or to demonstrate thrust. Studies can be made showing vocational possibilities. Basic aviation principles can be tested. Study can be made of the relations of air worthiness to design, types of wings, tail assembly, fuselage, and other parts of the airplane.

Courses in woodworking can include such activities as construction of wing and fuselage structure, binding of wood, application of plywood, wing skins and patches, and scale and flying model building.

Metal-working courses can include the layout, riveting, and fabrication of aluminum and its alloys, welding and brazing of tubing, repairs on metal wings, and the like. Electrical courses include simple wiring circuits, magnetism, theory of motors and generators, lighting, navigation or position lights, landing lights, and similar topics. Auto mechanics course can well include the airplane power plant.

2. *Vocational Industrial Education.* — The primary purpose of vocational industrial education is to develop competence to perform successfully in an occupation.

The abilities and attitudes which are developed in both the general and vocational studies are applied in every vocational situation. All successful vocational education is as much concerned with the development of desirable social and vocational attitudes as with the development of skill and technical knowledge. A wise teacher recognizes the various aspects of the personality of the student that will affect his achievement and emphasizes the significance of the vocation in his social and economic life.

*a. Criteria for the Establishment of Vocational Aviation Training Programs for Illinois.* — Only cities in the state that can develop *bonafide* CAA approved schools for training licensed aviation and engine mechanics should be urged to develop programs now. We believe that it is much better to develop a few centers as soon as possible rather than to have several small centers with training set-ups which could not possibly meet CAA standards.

To obtain essential local interest and support would seem to involve securing adequate space, instructors, small tools, some special equipment, benches, storage cabinets, parts cabinets, material for "mock ups," and the like, as well as paying freight charges on engines, planes, and other equipment from the air depots to the local schools.

Proper understanding between the regional CAA representatives, the State Vocational Department, and the local school must be established, especially in regard to future development within the state. Such relations should promote the highest standards obtainable.

It is desirable to develop good school set-ups especially in centers already offering vocational training in engine assembly or disassembly, or other courses.

Air service command training guides should be examined carefully with reference to their use in all aviation and engine approved schools. Costs will depend upon the local community and will vary several thousand dollars.

*b. Factors to Be Considered When Locating Aviation Training Centers.* —

(1) Airline terminal

(2) Probability of private flying contacts with the training center

(3) Supervisory personnel now available
(4) Evidence that plans for training are under way
(5) Potential development of the city as an aviation center as revealed by CAA plans
(6) Potential trainee and employee supply
(7) Type of aviation training now in operation in the proposed training center
(8) Quality of local staff
(9) Attitude of local administrative staff

*c. Items of Help to Be Furnished Local Schools by State Vocational Departments.*—

(1) Suggested shop layouts
(2) List of equipment for each unit
(3) List of small tools for each unit
(4) List of "must" standards for certification by CAA
  (a) Course outline of content built on shop analysis
  (b) Teacher's certification—aviation and engine licenses with CAA instructor rating
  (c) Building equipment to meet CAA minimum requirements
  (d) Length of courses to meet CAA minimum requirements
  (e) Records to include progress of trainee, of work, and overstock of equipment.

*d. Units of Instruction.*—

(1) Engines
  (a) Carburetor
  (b) Generator, starter, magnetic
  (c) Test and run up
  (d) Engines
(2) Airplane
  (a) Disassembly, assembly, rigging
  (b) Sheet metal
  (c) Fabric and woodwork
  (d) Dope and paint
  (e) Hydraulic system
  (f) Electrical installation
  (g) Propeller
  (h) Radio

*e. Entrance Qualifications.*—Students should not be admitted to a vocational course unless they have made an occupational choice. Admittance should also be restricted to those who are physically and mentally competent to do the work and who possess the qualifications required for employment in the type of work for which training is offered. Prerequisites for entrance should include one semester each of any two of the recommended industrial arts courses in metal work, auto mechanics, or machine shop; one semester in

each of any two of the courses in mechanical drawing, woodwork, or electricity is required for those who wish to begin their vocational courses in the eleventh year. Additional preliminary shop training may be required of some students before beginning their vocational work in aviation.

Trainees should receive at least four hours a day of shop work. Instructors should not have more than fifteen trainees at one time.

*f. Types of Aircraft Mechanics Training.* — The vocational courses in aviation mechanics should be offered in the eleventh, twelfth, and thirteenth years of high school. Vocational courses for aircraft technicians, such as meteorologists, navigators, inspectors, airport managers, and traffic controlmen, would extend through the fourteenth year.

Some of the aircraft mechanics training courses to be offered should include training for the following occupations: aircraft, woodworker, aircraft welder, aircraft fabric and finishing worker, aircraft sheet-metal worker, aircraft rigger, aircraft electrician, aircraft engine mechanic, aircraft engine electrical accessory, and aircraft instrument mechanic.

### AREAS FOR FUTURE STUDY

The foregoing discussion of a number of the principles involved in aviation education in schools has indicated that many problems are still to be solved in this field. A number of other problems not implied in the report up to this point were recognized by the members of the Committee. Among the more important problems requiring further study are these:

1. *What teaching materials concerning the impact of aviation upon society are now available?* — At present there are so many materials available, especially in the popular press, that teachers in search of instructional materials may find it difficult to avoid presenting misleading or contradictory information. The presentation of reasoned conclusions by recognized authorities in political science, medicine, agriculture, transportation, or sociology should do much to clarify conflicting conclusions in these fields. Such contributions may well be made through the use of the research facilities of institutions of higher education, the Civil Aeronautics Administration, or foundations and other organizations.

2. *What basic knowledge, attitudes, and skills related to aviation are needed by every citizen?* — The contribution of aviation education to the development of sound citizenship is recognized as of primary importance. However, the elements of aviation education which are essential to the achievement of this purpose either have not been clearly defined or have not been made available to teachers.

The procedures through which this question may best be answered involve the joint activity of teachers at the elementary, high-school, and adult levels through workshops or their own group meetings, through the distribution of the resulting proposals, and through experimental work with children and adults.

3. *How may teachers be kept currently informed of the instructional materials in the field of aviation?* — Aviation is changing so rapidly that the problem of keeping instructional materials current is discouraging to many teachers. A project is now being conducted under the auspices of the CAA for collecting and publishing sources of instructional materials for the use of textbook writers. Such a project should be continued indefinitely, and much of the material should be made available directly to teachers as well as to textbook writers.

It has been suggested that a source of current information on available materials in aviation education should be maintained by a Federal or state agency and that the information should be distributed by such means as a news letter.

4. *What results are secured through aviation education?* — The importance of the evaluation of all teaching is generally recognized, but in such a new and rapidly changing field there is need for especial emphasis upon this problem. The importance given to the CAA ground-school tests as measures of the accomplishment of students enrolled in high-school aeronautics courses has been questioned because of the difference between the aims of such courses and the aims implied by the tests. Few aeronautics courses and few of the programs for incorporating aviation materials in existing courses have been systematically evaluated.

The Civil Aeronautics Administration should be commended for conducting evaluation studies in a number of places. An extension of this activity to include broad participation in evaluation in many localities should be encouraged.

5. *What is the responsibility of the schools for training pilots who plan to use their skill for avocational or personal business purposes?* — Though this question is highly speculative at present, a few schools are now facing the problem, and a large number may face it shortly after the termination of the war. A definition of the issues involved with proposals which might apply in a variety of school situations should help schools in answering this perplexing question.

CALIFORNIA

AMONG RESPONSIBILITIES assumed by the public schools during the war, aviation education has proved to have special significance. Like English, mathematics, and training for physical fitness, it serves people in civil as well as military occupations.

In 1942, through courses of aircraft identification and aeronautics, aviation education was suddenly introduced into the curriculum alongside traditional subjects. In 1941-1942, classes of aeronautics, for example, were maintained in a dozen California high schools. But challenged to instruct thousands of youth in elements of the science of aviation immediately prior to their induction into the armed forces, over the summer of 1942 schools remade their programs. The subject matter was unfamiliar to the majority of teachers and such related topics as had customarily been included in ordinary courses of physics and trigonometry required radical re-emphasis. There was no supply of trained teachers. So teachers learned with their students. During the 1943-1944 school term, 194 high schools enrolled 4,661 students in aeronautics and in addition thirty-two had 2,288 students in classes of aircraft maintenance.

Because aviation education concerns many persons besides pilots, navigators, and maintenance crews, the experience of the schools during the biennium has value for the years ahead. To record that experience the State Department of Education assembled committees of elementary-school, high-school, and junior-college teachers and administrators to summarize their findings. With the assistance of the aviation education service of the Civil Aeronautics Administration, the committees met at Berkeley, May 18-20, 1944. Their reports and recommendations are herewith submitted for the information of schools that may wish to consider the place of aviation education in the school curriculum.

**WALTER F. DEXTER**
**Superintendent of Public Instruction**

AVIATION EDUCATION IN THE ELEMENTARY SCHOOLS

SUMMARY OF RECOMMENDATIONS

IT IS STRONGLY recommended that the educational leaders of California give careful consideration to the following matters in projecting their plans for the continued adaptation of the school programs to current educational needs:

I. The need to bring teachers, supervisors, and administrators to a full realization of the effects of the air age on every sphere of human life and activity.

II. The need for a searching re-examination of the elementary-school curriculum with specific reference to purpose, content, materials, and techniques of presentation for the effective guidance of elementary pupils in air-age education. The need for developing plans and procedures to incor-

porate suitable instructional content, materials, and curriculum techniques to give air transportation proper emphasis in the program.

A. Preparation of source materials.

B. Selection of appropriate materials significant for various age groups.

C. A dual approach to curriculum organizations; (1) introduction of content relevant to the air age in the several subject areas; (2) placement of specific units or areas of experience on the air age at appropriate age groups, for example, primary units dealing with aviation in the community, and intermediate units treating more specifically the global and scientific aspects of aeronautics.

III. The need for state-wide leadership in setting up teacher education programs to develop competence for instructing elementary-school pupils in air-age education.

A. Training leaders (a program for administrators and key teachers).

B. In-service teacher education through workshops, study groups, organized trips, work experience, demonstrations, interclassroom visitation, utilization of services of consultants and specialists from field of aviation (speakers, interviews, exhibits, special uses).

C. Pre-service education of teachers.

IV. The need for a statement of guiding principles for use by planners, leaders, and curriculum workers in developing all phases of air-age education.

RECOMMENDATIONS FOR ELEMENTARY EDUCATION

We are living in an age of rapid change. The air age is here. The world has become small. The advances made in air transportation alone during the past two years have surpassed those made in the previous twenty years. Not only is there universal understanding and acceptance of these facts by the public, but also it is recognized that the effect of air transportation is a major factor in bringing about a new order in our daily living. Postwar planners are everywhere making ready for still greater changes.

In contemplating the issues and problems to be faced in the immediate future, a number of questions of far-reaching importance come to the attention especially of those responsible for guiding the education of children for living in a rapidly changing democratic society:

A. What modifications in present living will have to be made in order to adjust to an era of high-speed travel, short-time schedules, and greatly accelerated travel on a local, state, national, and international scale?

B. What changes will be necessary to adjust to a way of life based on the need for a high degree of competency in handling rapid-speed precision machines and instruments, exact travel schedules, and more rigid routines of personal living?

C What adaptations will be necessary because of increased contact with people from other localities, with their varying interests, languages, occupations, nationalities, and governments?

D. How well will our citizens of tomorrow be prepared to adapt and adjust to a new system of interstate and international air transportation and the attendant relationships?

E. What problems of a more specific nature impinge upon the elementary-school curriculum? For example, new skills such as reading and using maps, charts, tables, and time schedules become imperative. Such important geographic factors as the relation of people to resources, industries, transportation take on new significance in the elementary school. "Time" and "speed" rather than "miles" and "distance" become concepts of space-place relationships. A new emphasis upon place-geography with air routes rather than topographical factors as the determinant of strategic locations will become necessary.

F. What effect upon the air-age curriculum will result from changing interests of children? What clues for the planning of curriculums and the effective guidance of children will be discovered through a study of the questions and activities of children themselves as they adjust to the era of air transportation?

In recognition of the relevance of the foregoing questions to the current educational scene, it is the belief of this Committee that a number of specific recommendations are demanded. From the many problems for education inherent in the air age, four areas have been selected as being particularly outstanding at present, especially with reference to the continuing development of elementary education in California for the present and immediate future. It is not the thought that these are the only major needs which exist, nor has the Committee the intention to convey the impression that the present statement does more than present a brief outline of some of the points for emphasis or guides to planning a dynamic curriculum.

It is strongly recommended that the educational leaders of California give careful consideration to the following matters in projecting their plans for the continued adaptation of the school programs to current educational needs:

I. The need to bring teachers, supervisors, and administrators to a full realization of the effects of the air age on every sphere of human life and activity.

II. The need for a searching re-examination of the elementary-school curriculum with specific reference to purpose, content, materials, and techniques of presentation for the effective guidance of elementary pupils in air-age education.

III. The need for state-wide leadership in setting up teacher education programs to develop competence for instructing elementary-school pupils in air-age education.

IV. The need for a statement of guiding principles for use by planners, leaders, and curriculum workers in developing all phases of air-age education in the elementary school.

I. *The need to bring teachers, supervisors, and administrators to a full realization of the effects of the air age on every sphere of human life and activity.*

It cannot be too emphatically stated that if we are to guide intelligently children's activities into deeper channels of understanding, positive attitudes, wholesome appreciations, and skills pertinent to living in a changing world order, there is need, first of all, to identify clearly the effects of the development of air transportation on the significant phases of human living. If informed appraisers of present-day education have any criticism of that education, it is to be found in their statements that teachers are not equipped with a thorough background of understanding of the problems with which they attempt to acquaint their children, and that teachers have a shallow knowledge of pertinent subject matter. Curriculum workers will largely agree that many failures in teaching social-studies-science units and other subjects result from the teachers' having only a superficial acquaintance with the basic content material or from their having acquired information concerning the subject only vicariously and so lacking the clarity and forcefulness of reality which comes from first-hand knowledge of the problem in question.

Basic knowledges and understandings regarding transportation, communication, economics, government, occupations, health, recreation, and intercultural relationships are important. For purposes of convenient classification, the following categories may be listed as indicative of the areas with which educators must become thoroughly familiar in this present day and age:

A. Advances made in air transportation in recent years and their implications for the present and future.
B. Elementary understandings of the forces of flight—the simplest scientific facts relative to such questions as why an airplane flies, facts about weather, air rules, and regulations.
C. The work done by aircraft and air transportation in all areas of life—its functions as an industry.
D. The history of aviation—especially from the point of view of its relation to the development of world transportation facilities and its effect upon commerce, industry, business, government, and culture.
E. The development of airports and airways with attendant problems in commerce, trade, government.
F. The science of air flight—evolution of the plane, types of planes, parts and functions of the same (in simple terms), the jobs that planes do in the world of today.
G. The use of modern scientific teaching aids in air transportation—maps, globes, charts, films, pictures, and instruments.

H. An approach to the study of air transportation problems which will give pertinency and meaning to such important concepts as herewith enumerated:

1. A new place-geography determined by air routes which no longer recognize land and sea factors as the only primary determinants of world centers of trade and population.
2. The concept of "basic geographic factors"—people, resources, industries, air transportation facilities—as important in determining international relationships in the future.
3. The concept of "time" and "space" as factors in modern life.
4. The concept of an interdependent, mutually developed "world community."
5. An increased importance of laws and rules as necessary in governing group behavior in the community, state, nation, and world.

II. *The need for a searching re-examination of the elementary-school curriculum with specific reference to purpose, content, materials, and techniques of presentation for the effective guidance of elementary pupils in air-age education.*

The curriculum of the elementary school is constantly in flux, and if it is to keep abreast of the flow of interests and needs of children as they grow up in a dynamic culture, it must constantly be modified. The elementary curriculum at the present time must be carefully re-examined in terms of its present and possible future effectiveness with reference to development in air transportation.

*Organization.*—The organization of the elementary curriculum should take a dual approach to the treatment of materials related to the air age. In addition to the introduction of pertinent content materials to the several subject areas as described above, it is recommended that the placement of specific units of work or areas of experience on the air age be made at appropriate grades in the elementary school. For example, there should be a major unit included in the primary grades dealing with aviation in the community and a major unit in the intermediate grades treating more specifically the global and scientific aspects of aeronautics. It is recommended that there should be sufficient flexibility of placement and of content to permit adaptation to local needs.

*Program.*—The program should include all aspects of human living and the new understandings and concepts of air transportation, including such as the following:

1. The importance of the space dimensions with its related time factor and lessening dependence upon waterways, harbors, and other topographical features.

2. The increasing interdependence of all people due to the ease and facility with which travel and human contacts are made.
3. Through the medium of more rapid transportation, the gaining of much more realistic, richer, and deeper understanding and appreciation of the peoples of the world.
4. A greater understanding of the increased importance of laws governing group behavior in our community, nation, and the world.
5. Through technology, that air transportation has become safe, dependable, and increasingly useful.

*Subject Matter.* — The subject matter of all areas of the curriculum—science, arithmetic, language arts, social studies, health, and so on—should be brought up to date to include material pertinent to changes which air transportation is bringing. Particular attention should be given to content related to global (air) geography, weather, place-geography as related to transportation, air routes, intercultural relationships, the increasing interdependence of all peoples—local, state, national, international—distribution of world's resources, a new science of navigation, plane design, the biology of flight, and local, state, national, and international air policy.

*Materials of Instruction.* — The materials of instruction for elementary education should be examined, modified, and supplemented in order to bring them up to date from a factual and scientific viewpoint. This will call for provision of the use of such materials as globes, air-age maps, charts, graphs, films, slides, models, instruments, diagrams, and pictures, as well as new reading material.

It is to be recognized that the most potent of all instructional materials is the first-hand, on-the-spot, actual contact with the learning situation, whether it be a visit to an airport, airplane factory, an air depot, the ticket office, or a pilot training school.

In the field of materials for use within the classroom, there is need for the preparation of many types of new teaching and learning aids. The sound film should prove to be an instructional aid of the first importance. In this area films are needed which will help children on the several maturity levels to understand important air-age concepts. These include films showing the importance of weather to air transportation, and the function of the various air-service groups, such as sales agencies, service crews, flight crews, and the like. Such films as the following are needed:

1. Films showing the orderly development of a trip by airplane: preparation for journey, getting to airport, purchasing ticket, boarding plane, dining aboard plane, meeting fellow passengers, and the like.

2. Films showing the steps in preparing for take-off of all types of planes as well as similar needs for landing.
3. Films depicting the history of transportation.
4. Films of the modern airport—its layout, building, directional guides, operators, and the multitude of services performed by airport attendants.
5. Films showing the flying of gliders.
6. Films stressing global aspects of modern transportation, showing how the airplane has overcome obstacles of distance and land barriers, and emphasizing intercultural relationships and unity.
7. Films on modern aircraft construction, showing the processes from raw materials to completed plane.
8. Films showing some of the dramatic uses of the airplane in times of peace—in bringing help to people in distress, in delivering perishable goods, in fighting forest fires, in carrying the mail, in destroying pests, in planting crops, and the like.
9. Films on weather and its relation to commercial air transportation.

Similar types of visual material are needed in the form of film strips, still film, and flat-picture sequences.

Likewise, need for new materials exists in the field of books and written material. Following are a number of materials which may be suggestive of types of source information needed for children. In many instances teachers and curriculum workers might prepare such for children:

1. Children's materials showing men and women at work on different types of construction and assembly of planes.
2. Materials on the weather and its relation to flying planes.
3. Materials on kinds of work planes do—training, transporting passengers and freight, patrolling, fighting, and the like.

Children's stories should include the following types of subjects: the importance of people in the history of aviation, stories of important workers in aviation, stories of how airplanes serve people in modern life, stories centering upon the use of the airplane in cementing together world groups, peace conferences, assistance to neighboring peoples in distress, stories of the uses of planes in the transport of basic commodities, stories of flight with emphasis upon importance of the pilot and other workers who help guide the plane.

Similarly there is need for new materials in the form of maps, charts, models, plans.

III. ***The need for state-wide leadership in setting up teacher education programs to develop competence for instructing elementary-school pupils in air-age education.***

There is great need at the moment for a carefully planned and executed program of training for administrators, supervisors, and teachers in the field of air-age education. Such a program would involve three particular groups — leader groups (a plan for administrators, supervisors, and teachers); in-service teacher groups; and in-training teacher groups.

*The Training of Leader Groups.* — It is the recommendation of the Committee that the State Department of Education promote the development of workshops under the sponsorship of universities and colleges engaged in teacher education and that these workshops be planned primarily for principals, supervisors, and key teachers who, in turn, can set up workshops for the teachers in their own systems.

It is the feeling of the Committee that if California leaders in education are to inspire and instruct the teachers of the state for the task ahead they should have an opportunity to become acquainted with the same materials and techniques as they wish teachers to use in their classrooms. Such workshops, therefore, would minimize the traditional training devices as lectures, voluminous reading assignments, symposiums, panel discussions, and the like, and would capitalize on every possible medium for concrete first-hand experience. Included in the types of activities conducted by such workshops are the following:

1. Visiting airplane factories, airports, and the like
2. Learning elementary principles of flight and other background information concerning aviation
3. Constructing models and miniatures that will help children to clarify ideas and to manipulate for better understandings. For example, models of various types of planes, airport hangars, buildings, lights, windsock
4. Manipulating models to learn the parts of a plane and their functions
5. Preparing diagrams, layouts of an airport, charts, and graphs
6. Preparing exhibits and displays
7. Manipulating and demonstrating instruments
8. Using films, pictures, maps, globes, charts
9. Evaluating materials
10. Learning some of the rules of the airways, provisions for safety, and the like
11. Working with various map projections to learn their uses and values
12. Plotting air routes
13. Locating major airports of the world
14. Studying flight plans

15. Making slides
16. Preparing illustrated time lines showing the development of air transportation
17. Preparing scrapbooks
18. Compiling picture files of planes and data on air travel.
19. Doing research and preparation for developing sequences of experiences and activities possible for classroom use, i.e., thinking through an anticipatory sequence for a unit of work
20. Reviewing, evaluating, and planning for the use of films and other visual materials
21. Preparing curriculum materials in the form of resource information for children in the various subject areas.

Leadership for such workshops should be selected from those services which would best provide people who are fully aware with the possibilities of air-age education. In addition to educational leaders in the field of general elementary education, industrial art, science, art, music, language arts, and the like, individuals would be selected from other groups such as airline personnel, airplane manufacturers, and the Civil Aeronautics Administration.

*Workshops for In-Service Teacher Education.*—It is recommended that workshops, demonstrations, and other learning situations should be provided for teachers which would give them the basic information and experience needed to direct children in activities significant to air transportation. In the training of leaders, every opportunity should be taken to make the work practical by including first-hand experiences of the type which would provide the teacher the same opportunity as she would offer her pupils. Under the guidance of trained leaders, the in-service training workshops for teachers would include similar types of activities that were conducted for the training of teachers.

*Pre-Service Training of Prospective Teachers.*—It is recommended that teacher training institutions give emphasis to those aspects of air-age education which will help beginning teachers intelligently to guide a generation of children who are, for the most part, far ahead of their elders in understanding the scientific and social implications of the air age. Such a training program would be realistic to the extent that actual first-hand experience is the best teacher. Teachers in training would be given opportunity to gain a thorough understanding and appreciation of air transportation by actually participating in some phases of air-age work, whether it be in the factory, at the airport, or in the air. There is reason to believe that prospective teachers could profit much through participating in workshops with teachers in service.

It is recommended that workshops for the teachers of the state be planned in such manner as to provide the greatest service for the greatest number of teachers in each particular administrative unit. In some instances, workshops might be conducted over a period of weeks throughout the fall or spring semester. Such groups might meet after school for an hour once a week or on Saturdays. In other localities teachers may come together from several schools on a similar schedule. The practice of planning workshops for interested teacher groups following the close of the spring semester or just prior to opening of the fall term is to be commended. Likewise, the present growing tendency of teacher-education institutions to provide one or more short-term (two to four weeks) workshops in connection with summer-session programs is most desirable.

IV. *The need for a statement of guiding principles for use by planners, leaders, and curriculum workers in developing all phases of air-age education in the elementary school.*

It is the belief of the Committees that certain over-all basic principles should govern the treatment of air transportation in the program of the elementary schools. The following list of principles, although not complete, includes some which are considered most pertinent:

1. The program of activities for air-age education should be entirely in harmony with the present state program of elementary education.
   a. It should take cognizance of basic philosophical principles, including the recognition of democratic procedures and provision for recognition of basic child interests and needs.
   b. It should be in harmony with the present structural organization and especially with the framework of education currently being prepared by state groups for consideration by the California State Curriculum Commission.
2. Because of the dynamic nature of air transportation, elementary school activities related thereto should provide much opportunity for the stimulation of interest on the part of children, the satisfaction of their natural curiosities, the provision for manipulating, the provision for physical activity, the provision for co-operative enterprise, the provision for creative expression, dramatic skills, and scientific thinking.
3. To avoid duplication of air-age education and to promote the fullest progress in society, the selection and introduction of content materials and activities must be made in terms of children's interests, needs, and abilities.
4. The factual information related to air transportation should be kept on a level of simplicity and clarity commensurate with the maturity of children and within their range of experience and understanding.

5. All materials and information used by children must be carefully scrutinized for validity and authenticity.
6. The immediate environment should serve, where possible, as an approach to air-age education.
7. Because of the rapidly accumulating body of information and materials, care should be exercised in selecting only those materials which are most pertinent for use on the elementary level. In this connection, attention should be given to the elimination of certain obsolete materials.

### AVIATION EDUCATION IN THE HIGH SCHOOLS

#### GENERAL OBJECTIVES

The secondary level of our American public school system should be vitally concerned with aviation education. The study of the impact of man's ability to fly upon the local, national, and international way of living can be made a definite contributing factor in the preparation of youth to live intelligently in an everchanging civilization. Through aviation education, three of the seven objectives laid down by the Commission on the Reorganization of Secondary Education in *The Cardinal Principles of Secondary Education* are aided directly in their achievement: (1) citizenship, (2) vocation, and (3) worthy use of leisure.

"Civic education" is fostered in the modern world through an understanding of aviation as an important factor in political, social, and economic developments.

With the growth of the aviation industry to a point where, in wartime, aircraft production alone exceeds tenfold the automobile industry at its peak, the "vocational" aim in aviation education would appear to be of major importance. A program which would truly realize the vocational aim of aviation should include exploration, guidance, training, and placement, and should be presented in such subject fields as science, mathematics, social studies, industrial arts, and vocational education.

In the attainment of the aim of the worthy-use-of-leisure, aviation offers a rich field for the development of hobbies and avocational interests. Schools should take advantage of the universal and deep-seated desire of youth to learn about flying, to build and fly model planes, to learn something of the mechanical structure and operation of the airplane, to read and write about aviation and air heroes, and other wholesome in- and out-of-school activities found in our present age.

Without recognition of the changes being brought about by the advent of the airplane and without a subsequent reorganization of its curriculum in keeping with these changes, the school fails in its obligation to youth and society for which it exists. Just as changes come gradually in a new advance in civilization, so also the school should not strive to introduce revolutionary changes in its program. What is needed is an intelligent analysis by each school

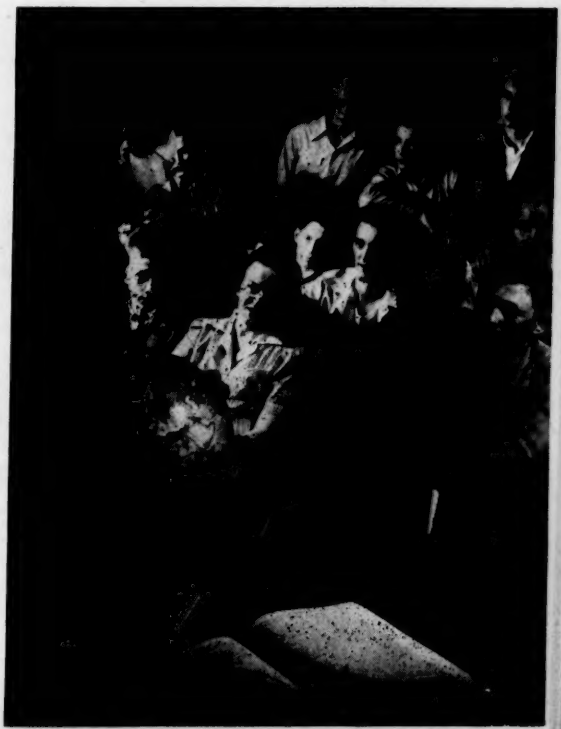
of the implications the air age has and will have upon the youth it serves and then proceed to do something about it.

The Committee offers the following twofold general objective as a guide for setting up specific objectives for aviation education in the junior and senior high schools of California:

1. To enrich and modify the curriculum by adding or weaving into existing courses learning activities from the field of aviation appropriate to the level and course content and in keeping with the objectives and philosophy of the school. Such activities may include aviation readings, facts, special reports, current events, outside speakers, vocabulary, discussions, compositions, or complete units of instruction built around some phase of aviation related to the course objectives.
2. To add to the curriculum new courses in aviation which meet the needs of youth and society. Every high school should attempt to offer at least one course devoted entirely to a study of the science of aeronautics. Where the demand exists additional courses (vocational, industrial arts, or special preflight training) should be provided.

### AVIATION EDUCATION AS AN ENRICHMENT PROGRAM

The committee recommends that teachers in all subjects capitalize widely and freely on the achievements and developments of the air age as it relates to the activities of each class. Teachers will not only be modifying the present program in keeping with the new developments, but also will be utilizing the general tendencies of pupils to achieve more readily and effectively the objectives of the course or subject. In this way it is possible to use aviation as a vehicle by which certain skills, appreciations, facts, and understandings can be achieved. Aviation can serve as a rich and timely source of appli-



**Polytechnical high-school students of Fort Worth, Texas, find the study of world geography really enticing in this modern air age in which they are living.**

cations and problems particularly for general science, biology, physics, chemistry, mathematics, industrial arts, fine arts, and social studies. English, languages, the arts, and other courses will discover new and worth-while source materials in the stories, poetry, terminology, and drama of aviation—past, present, and future.

Because of the wealth of instructional materials available in the form of magazines, pamphlets, books, films, pictures, charts, and graphs, the teacher should become acquainted with the increasing flow of publications and make a selection of the most appropriate and worth-while supplementary teaching aids. The bibliography included in this publication is selective and merely serves as a beginning. It is suggested that schools appoint a teacher committee or ask the librarian to select, secure, and recommend aviation materials and indicate where and how such materials might best be used.

It cannot be expected that every teacher will develop new units, new applications, new discussion problems, and the like in a field as broad and new as aviation. The Committee urges strongly, therefore, that educational organizations concerned with the improvement of classroom instruction take cognizance of the need for aiding teachers interested in aviation education to discover new approaches and procedures, and to develop teaching materials and units of instruction. There is a growing need for evaluating aviation materials coming to the school from many sources. Such evaluation should consider the accuracy, "teachability," and desirability of new materials. The California Mathematics Council has taken the lead by appointing a subcommittee to its Research Committee to study the place of aviation in mathematics teaching. Similar studies should be made especially in the sciences, social studies, and English. The State Department of Education is urged to exercise its leadership by setting up state-wide committees or workshops to develop means and methods to aid the induction of aviation education in junior and senior high-school programs. If feasible, the Division of Secondary Education should serve as a clearinghouse and as such should publicize successful teaching practices, units of instruction, and teaching materials as they are developed and tested in the field. It is important that such proved aids be distributed to all schools.

### AVIATION EDUCATION IN THE JUNIOR HIGH SCHOOL

The junior high school can make its best contribution to aviation education through the enrichment program approach. Wherever it is appropriate, courses should be modified to include aviation units, illustrations, applications, and implications which are timely and meaningful to boys and girls of junior high-school age. Units on aviation can best be added to the science, social science, and industrial arts programs.

The extra-class program is a fruitful area for aviation experiences. Here model airplane clubs can design, build, exhibit, and fly planes of all types.

Identification of aircraft and radio code practice also constitute worth-while club activities.

In general the kind of aviation activities and topics that boys and girls in grades seven to nine can engage in with interest and success include vocabulary building; reading aviation books and periodicals, current events, special reports on aviation developments; and class discussions of aviation topics, air heroes, air battles, airplane speed and performance records, airplane designs, drawings, and sketches, airplane models, aircraft identification, air transportation, airports, and the future of aviation.

The Committee feels that much work and experimentation must be done before the part aviation education should play in the junior high-school program becomes known. The Committee does not favor at this time the organization of separate courses in aviation for the junior high school, since no objectives not already a part of the regular secondary-education program can be advanced to justify them.

### COURSES IN THE SCIENCE OF AERONAUTICS

The educational objectives which support the programs for incorporating appropriate aviation materials into all subjects at all grade levels are equally valid aims for courses in the Science of Aeronautics. Although separate aeronautics courses contain added and more specific purposes, it should be remembered that one of the important phases of general education is the understanding of modern science and its social implications.

More specifically, one or more of the following reasons substantiate the inclusion of at least one course in the Science of Aeronautics: (1) to offer instruction in the science of aeronautics within the framework of general education; (2) to assist students in understanding the social significance of the airplane in war and in peace; (3) to provide a background for intelligent participation in the development of aviation in the postwar world; (4) to aid in preparing pupils for military training, particularly for the air service; (5) to aid in preparing pupils for active participation in the aviaton industry; (6) to provide a general aeronautics background preparatory for more specialized courses to be taken in the high school or at higher institutions; (7) to utilize the genuine interests and fulfill the felt needs of pupils in aviation; and (8) to assist pupils to prepare for the private pilot ground-school examination of the Civil Aeronautics Administration.

*The General Course in the Science of Aeronautics.* — The Committee recommends that every high school offer a one-year course to be called "Science of Aeronautics" and organized for qualified eleventh- and twelfth-grade boys and girls. Since it is believed that sharply prescribed prerequisites would serve to defeat one or more of the objectives of the course, schools for the next few years should keep prerequisites flexible and at a minimum commensurate with worth-while outcomes. Evidence seems to indicate that the pupil's genuine

interest and desire to achieve may be better indicators for selection than his past academic record in mathematics and science. A background of one year of mathematics and one year of science (not necessarily physics or chemistry) should be ample preparation for a pupil to be able to succeed in a general aeronautics course. Whatever prerequisites are set up should be sufficiently flexible to admit a pupil when his program, abilities, purposes, and interests make it reasonably clear that he could profit from the course in aeronautics. This pertains particularly to small schools where the course may be alternated.

No one objective of the course should be emphasized so as to exclude pupils qualified to take the course. For example, if the sole objective is "pre-induction," girls are excluded in fact if not by a specific prerequisite; whereas from the viewpoint of interest and general education value, girls should be encouraged to enroll on an equality with boys.

The content for the Science of Aeronautics cannot and should not be definitely prescribed by this Committee because of (1) the great variation in teacher training and experience; (2) the variation among schools in setting forth the prime objectives of the course; (3) the differences in prerequisites and subsequent selection of students; and (4) the indefinite and changing demands and requirements of advanced training in industry or in private flying. Nor should texts or printed courses of study unduly fix the content. The trend to exclude the more technical phases and problems of aerodynamics, meteorology, and navigation in favor of a broader and more general treatment is to be encouraged. In addition to the three basic units mentioned above, the study of power plants, civil air regulations, general servicing and maintenance of aircraft, and significant social implications and applications stemming from the science of aviation should be included. It is recommended that complete units in identification, radio code and the like be a part of the elective or extra-class program instead of being an integral part of the Science of Aeronautics. It is also thought to be advantageous to have the content arranged in such a way that the work for each semester can be taken independently.

*Vocational Aviation Courses.* — To fulfill the strictly vocational training need of qualified pupils, larger schools are encouraged to organize a vocational program in aircraft mechanics and aircraft engines. The most feasible and direct approach is to organize in so far as possible such a program under the provisions of the California Plan for Vocational Education. It is recommended that only those schools attempt to set up an aircraft mechanics and aircraft engines vocational training program who meet the following requirements: (1) a sustained enrollment sufficient to warrant an aviation vocational program; (2) location in a community or area where there are employment possibilities; and (3) satisfactory provision for school housing and special equipment.

*Industrial Arts Aviation Courses.* — The Committee believes that there is a very definite need for a separate course in aviation education in the area of

industrial arts. The following objectives for a separate one- or two-year course seem justified: (1) to provide opportunities for laboratory-type experiences not included in the Science of Aeronautics; (2) to provide opportunities for students to explore various aviation fields having vocational outlets; (3) to provide training in general aviation mechanics; and (4) to serve as a try-out and preparatory course for further vocational training.

It is recommended, therefore, that a one- or two-year industrial arts course to be called "General Aviation Mechanics" be organized on the high-school level which shall include laboratory-type units of experience in the following:

Aircraft structure
Aircraft engines (including propellers)
Aircraft metal work
Aircraft wood work
Aircraft electrical work
Aircraft hydraulics
Aircraft instruments
Aircraft drafting
Aircraft controls

The laboratory work in the General Aviation Mechanics course will necessitate a separately equipped aviation mechanics laboratory. This laboratory should serve a double purpose by being readily accessible to classes in Science of Aeronautics.

In view of the fact that provisions are now in force for granting vocational credentials in aircraft engines and in various fields of aircraft mechanics and since no similar provisions have been made for granting an industrial arts credential, it is urged that General Aviation Mechanics be added to the recognized list of industrial arts courses for which credentials may be granted. It is further recommended that a suitable teacher-training program be set up for presenting this course.

### AVIATION COURSES FOR ADULTS

Recognizing that education does not and should not cease with high-school or college graduation and that the adult education program in California aims to serve education needs of the community, the Committee recommends that aviation education become an integral part of the adult education program. Furthermore, it seems advantageous to have high-school pupils made aware of the opportunities for continuing and enriching their aviation training through the adult education program after leaving school. Courses which have been found to be successful in the adult program are the following:

Radio code
Meteorology
Air navigation
Ground-school preparation
Aviation cadet refresher course
Aviation mathematics
Radio fundamentals
Aircraft welding
Aircraft sheet metal
Aircraft engine repair and maintenance

### PREPARATION OF TEACHERS

Since probably only one-half of the teachers of aeronautics in California have received some kind of formal instruction in aeronautics, there exists a real need for a more extensive in-service and pre-service teacher-training pro-

gram. The following groups of teachers could profit from a variety of practical experiences and suitable course work:

1. Mathematics, aeronautics, and other science teachers
2. Junior and senior high-school teachers of other courses including elements of aviation
3. Industrial arts teachers

It is urged that school administrators consider it their responsibility to encourage, guide, and aid teachers to take advantage of one or more of the following means of acquiring training:

1. County and city institutes, workshops, and special committees
2. Adult education programs
3. Summer session offerings
4. University and college extension services
5. Civil Aeronautics Administration education services including airport operations institutes, evaluation conferences, and consultant services
6. State Department of Education sponsored meetings, committees, projects, and the like
7. Conferences and other activities of educational organizations and associations
8. Industrial, aircraft, and airline educational services
9. Community aviation advisory and planning committees

Not all of such teacher-training resources are now primarily engaged in aviation education, but probably they would respond to an organized request for whatever aviation training falls within the scope of their respective programs. For example, University of California extension classes are organized throughout the year in regular extension centers, and upon sufficient request, in other California communities. It is suggested that administrators and supervisors provide the leadership in organizing activities and opportunities for teachers to become proficient in the role they must play in introducing and maintaining a program of aviation education in our schools. Attention is also directed to the advisability of utilizing fully the aviation experience and training gained by teachers who have returned from military service.

### ARTICULATION OF AVIATION EDUCATION

During the formative period of experimenting with a program of aviation offerings in the junior high schools, the high schools, the junior college, the trade schools, the colleges, and the universities, particular attention should be given to the problem of articulation. Students leaving high school can be grouped into five categories for their aviation training:

1. Those who have had specific aviation training in their vocational program
2. Those who have taken a general mechanics course in a prevocational industrial program
3. Those who have taken one or more courses in the science of aeronautics

4. Those who have had some combination of the foregoing
5. Those who have had no course work in aviation

To insure better articulation between the high-school and other school levels the Committee offers the following suggestions:

1. The high school should become acquainted specifically with the aviation education programs of the institutions to which it sends its students
2. The high school should indicate specifically on the high-school transcript the aviation training received by each student
3. The high-school and post-high-school institutions should make every effort to co-ordinate their guidance and counseling programs. This will make it possible for the student and the institution to plan a long-term program, eliminate unnecessary duplication of course work, and aid in creating a curriculum based upon student needs, interests, and abilities
4. High schools and junior colleges, particularly, should develop a closely co-ordinated guidance and aviation education program.

### NON-SCHOOL AVIATION EDUCATION PROGRAM

There is an increasing number of non-school agencies engaged in some sort of aviation education program. Among the more active organizations are the following: Civil Air Patrol, Aviation Education Service of the Civil Aeronautics Administration, Air Scouts (Boys), Wing Scouts (Girls), Glider Clubs, Model Clubs, Airlines, and Aircraft Manufacturers. It is recommended that the high schools become acquainted with the objectives and activities of the various non-school aviation education programs and, in turn, inform the sponsoring agencies of the school's program in aviation. To insure co-ordination and to avoid unnecessary duplication of efforts, the school personnel should be encouraged to participate actively in desirable non-school aviation projects. Such participation by school personnel should aid in formulating the educational policies of outside aviation activities. The schools should assist and encourage non-school aviation activities to the extent that they supplement the program carried on in the school. In some areas it would seem desirable that there be established community advisory committees on aviation education whose aim it would be to co-ordinate and stimulate school and non-school aviation programs.

### SERVICES OF STATE DEPARTMENT OF EDUCATION

The Committee recognizes that a program as new as aviation education will undergo many changes and develop differently in the various school systems of the state. This is as it should be. There are, however, certain problems common to all schools which need the assistance and guidance of the State Department of Education for solution. The following are some ways in which real help can be given by the appropriate divisions of the State Department of Education:

1. Encourage and assist in developing and experimenting with instructional methods and materials in the various areas of aviation education.

2. Collect, evaluate, and distribute aviation units of instruction which have been found to be successful.
3. Evaluate available instructional aids including reading materials, audio-visual aids, laboratory equipment, and special devices.
4. Encourage and assist in developing plans for postwar school-housing which take into consideration aviation equipment, airplanes and aeronautics laboratories, shops, and hangars.
5. Assist in securing surplus military equipment of use to aviation education programs. Link trainers, small training planes, training films, laboratory demonstration equipment, small engines, and airplane parts should be made available to schools in quantity after the war.
6. Appoint and assist special committees to work on specific common problems in aviation education.

### FLIGHT-EXPERIENCE PROGRAM

It was the consensus of the Committee that actual flight experience constituted an effective and necessary part of any complete and successful high-school program of aviation-science instruction. This recommendation is based upon a conviction that a flight experience program is feasible and that it provides the means whereby courses in the science of aeronautics and general aviation mechanics as outlined in this report can become and remain functional courses in the general education curriculum.

*1. The Purposes of Affording Flight Experience*

Although each school district will and should set forth its objectives for a flight-experience program in keeping with local conditions, facilities, needs, and interests, the following general statements may serve as guides for developing such a program:

a. The primary purpose of flight experience should be to provide opportunities for pupils enrolled in courses in science of aeronautics and general aviation mechanics to experience firsthand the demonstration of flight principles and operation of equipment. Only by direct observation of activities that utilize the airplane, the airport, and other facilities for flying can the learner appreciate and understand fully the facts, concepts, theory, and relationships of aviation. A high-school flight experience program should be planned and organized to provide abundant opportunities for aviation experiences. Such a program would go far to enrich the entire school curriculum.

b. The flight experience program should be carefully and thoroughly organized to insure the greatest possible safety and instructional demonstrations of the highest quality.

c. Flight experience should be incorporated as an integral part of aviation courses, whether in the academic, industrial arts, or vocational depart-

ments. It is recognized that the flight instructor will have to be trained to emphasize the demonstration of flight principles instead of concentrating upon the teaching of flight skills.

*2. Suggested Organization of the Flight Experience Program*

The following suggestions for the organization of a high-school flight experience program are offered to indicate the basic aspects that must be considered. The details should not be thought of as more than suggestions; the final form of any program will have to await much experimentation and experience.

*a. Form of Organization.* — A written contract for the use of facilities and equipment, including fuel, maintenance, insurance, as hereafter noted, and everything necessary for the lawful operation thereof, should be entered into between the governing board of each district and the owner of such facilities and equipment (hereinafter called the contractor). It is suggested that the legal representative of the governing board prepare the contract according to local conditions and in conformity with forms recommended or prepared by the State Department of Education. The principal terms throughout to be desirable in such a contract are listed later in this report as a guide for developing an organization.

The employment of a qualified person as a flight instructor should be accomplished in the same manner as in the case of any other teacher employed by the district. Only such persons as have an appropriate credential of the State Board of Education and are licensed as instructors by the Federal agency having jurisdiction may be employed.

*b. Amount of Flight Time.* — The flight experience program should offer a total of four hours of flight given as eight lessons of approximately thirty minutes in length. Such lessons should be given in a trainer-type airplane equipped with dual controls, which will facilitate the instructor's explanation of the maneuvers. From an analysis of the flight exercises and the recommendations of flight instructors, a program of less than four hours seems inadvisable.

*c. Content.* — The content of the eight half-hour lessons given below is organized and selected to provide a maximum of maneuvers and practices that demonstrate flight principles and afford opportunities for flight experience. Development of skills in the manipulation of an airplane, or perfection of flight maneuvers are not the purpose of the flight experience program. The fifteen-minute ground instruction preceding each flight should consist of simple explanations of controls, instruments, throttle, brakes, fuel system, safety belt, and other safety devices. In addition, safety precautions and habits around the airplane, traffic rules, and use of the parachute should be stressed. Each pupil should also make one aircraft inspection. The following maneuvers should be demonstrated:

*Lesson*

I. Taxiing, straight and level, turns, effect of controls

II. Taxiing, straight and level, turns, co-ordination exercises

III. Taxiing, straight and level, turns, co-ordination exercises, confidence maneuvers, climbs and turns, glides and turns

IV. Taxiing, climbs and turns, straight and level, co-ordination exercise, glides and turns

V. Taxiing, take-offs, climbs and turns, co-ordination exercise, stalls in turns, etc., glides and turns, approach 90°, landing. Considerable ground instruction should be given on stalls and the beginning of spins as they apply to turns, climbs, glides, recoveries, and other maneuvers.

VI. Taxiing, take-offs, climbs and turns, co-ordination exercise, stalls—stress accidental, S-turns, glides and turns, approach 90°, landing

VII. Taxiing, take-offs, climbs and turns, S-turns, co-ordination, climbing and gliding exercise, glides and turns, approach 90°, landing, spins—accidental and intentional. Spin demonstrations should be given in either lesson seven or eight, dependent upon conditions. Short cross-country flight.

VIII. Taxiing, take-offs, climbs and turns, S-turns, co-ordination climbing and gliding exercise, glides and turns, approach 180°, landings Lessons constitute a cross-country flight experience exercise, in addition to a selected number of maneuvers not already demonstrated in previous lessons.

Some schools have found classroom flight trainers to be of value, particularly as an excellent motivating factor. Link trainers should also prove to be value either as a supplement to flight experience or in schools where a flight experience program is impossible.

*d. Equipment.* — The contractor should provide trainer airplanes of not less than fifty horsepower, equipped with dual controls, brakes, sensitive altimeters, compasses, and other standard equipment required by the Civil Air Regulations. The trainees should carry equipment enabling the instructor to see and speak to the public as a means of facilitating explanation of maneuvers. Parachutes, maintained in accordance with Civil Air Regulations, should be provided for both pupil and instructor and worn on all flights.

*e. Personnel.* — No instructor should fly more than eighty hours in any thirty-day period. The flight experience program and, in particular, the ground instruction, should be planned in conjunction with, and in co-operation with, the aeronautics courses.

*f. Evaluation.* — The flight instructors should log the flight experience time of each pupil after each flight in log books to be furnished by the school district. The books should be signed immediately after each flight. Log-books should never be signed in blank. Each week each instructor should furnish a

report to the school on the progress of each pupil assigned to him and he should co-operate in preparing and administering any tests and examinations to be taken by pupils during or at the completion of their four hours in the air. A texting program should be outlined specifically by school representatives and the flight instructors.

*g. Insurance.* — The contractor should provide public liability insurance protecting himself, the flight instructors, the school district, the members of the governing board, the school teachers, and the pupil. Public liability protection in the amount of $50,000-$100,000, and property insurance covering all aforementioned parties to the extent of $10,000 is recommended. In addition, the pupil should be covered in the amount of $3,000 in case of death and $500 for hospital and medical expenses he may incur as a result of accident in flight or incident thereto.

*h. Costs.* — Actual amount of time given pupils in flight experience should be the basis used for computing the compensation to the flight instructor. At present, the total cost of providing flight instruction of the kind recommended here is approximately $10 an hour. In all likelihood this price will be materially reduced in the future. It is suggested that the school district be responsible for transporting pupils to and from the airport. In general, boards of education are urged to pay a rate commensurate with and conducive to satisfactory and safe instruction.

*3. Flight Contract Provisions*

In general, the Committee strongly urges each school district desiring to establish a flight experience program to outline carefully its objectives and flight program before deciding upon the specific provisions of the necessary contracts. The written contracts should specifically state the exact conditions that shall govern every phase of the program.

The following provisions, in addition to those implied or stated previously in this report, are suggested as desirable. The specific wording should, of course, be decided upon by the legal representative of the governing board of the school district:

1. No responsibility for negligence on the part of the contractor or his employees should be permitted to be passed on to the school district, or its employees, or the board of education.
2. The contractor should be one maintaining an approved flight school in accord with provisions of the Civil Air Regulations.
3. The contractor (instructor) should be responsible for co-operating with the authorities of the district in establishing a definite pattern flight demonstration at the airport. This pattern should include demonstrations of taxiing, take-off, flight, flight maneuvers, and landings, and should be enforced at all times.

4. At least daily inspection of each aircraft used for flight instruction should be required and the results of the inspections recorded and signed by the contractor or a person responsible to him.
5. All records showing CAA inspections of personnel and equipment used in the flight program should be made available to the school representatives.
6. The contractor should have the right to discontinue or refuse the use of facilities and equipment by any pupil for flight instruction for sufficient cause, after consultation with school authorities.
7. It should be possible to cancel a contract with a contractor upon thirty days' written notice at the option of either party.

### PILOT TRAINING

Pilot training for private flying to qualify pupils for a private pilot's license under Civil Air Regulations should follow approved patterns already developed by the Civil Aeronautics Administration for primary flying schools. Such training should not be terminated, except in cases of failure of the pupil, short of the thirty-five to fifty-hour program essential for competence. Pupils whose aptitudes and competence in aeronautics make them eligible for pilot training should have the opportunity for the maximum flight training course. Few, if any, high schools can offer this maximum training which belongs essentially within the scope of the junior college course. Establishment of flight-experience courses is recommended for high schools by the Committee on the principle of service to the greatest number of pupils enrolled in the science of aeronautics and aviation mechanics courses.

## AVIATION EDUCATION IN THE JUNIOR COLLEGES

The air age is upon us. If nothing else had brought about a recognition of this fact the daily exploits of our former students now engaged in the war have done it. Children and youth now in our public schools will fly; they will fly a great deal and many of them will fly their own equipment. The life of the entire globe will be changed in revolutionary ways as a result of the age of flight. It is, therefore, imperative that careful thought be given to the ways in which education should be adapted to the needs of this new age. These adaptations will differ with different levels of the school system. Many will affect all levels. There will also, however, be certain adaptations peculiar to each level.

The Junior College Committee of the Aviation Conference has largely confined its thinking to the adaptations in junior-college education which the air age implies. It has been the philosophy of the group that the public junior college in California is a community college, the capstone of the secondary-school system. The state's obligation to provide free public education for its citizenry at the junior-college level implies services to three groups of people:

(a) adults; (b) youth headed for university degrees; (c) youth expecting to terminate their formal education in junior college. For all three groups it is important that each person be aided in establishing or maintaining: (a) economic competence, both as a producer and as a consumer; (b) personal adjustment, both physical and mental; (c) socio-civic adjustment, to enable him to be a worthy member of his society. That such obligations on the part of the junior colleges deserve public support since they are in the interest of our entire society has been accepted as axiomatic.

In the light of the two already briefly mentioned frames of reference, namely, the presence of the air age and the responsibility of public education to meet the needs of its citizens, the Committee submits for careful examination the considerations and recommendations which follow.

## EDUCATION FOR VOCATIONS IN AVIATION

### *A. Scope*

Aviation has already become a major industry. Although the exact number of persons employed in aviation today is difficult to state because of wartime restrictions and secrecy, it is known that a very large number of people are employed in the many aspects of the industry. As aviation is a rapidly expanding field, it is highly probable that for some years to come it will constantly require a large number of new employees. Aviation personnel trained during the war may provide a temporary surplus, but this is somewhat problematic, as many would require additional training, and the number who may choose to remain in the field is unpredictable.

There are positions within the aviation industry for a great variety of workers, involving a wide variation in the amount and kind of education needed to hold the position successfully. Since a great many of the positions related to this industry are on the semi-professional or technical basis, some even on the trade basis, it is clear that junior colleges will need to be prepared to offer a considerable number of vocational curriculums preparing men and women for entrance into the aviation industry. It is to be noted that these vocations are not solely those related to aircraft production, but to a large extent are occupations related to aircraft maintenance, airport operation, and related-service occupations. Illustrative of the kinds of occupations related to the aircraft industry for which junior colleges may well prepare students, the Committee suggests the following outline:

### SUGGESTED VOCATIONAL COURSES IN AERONAUTICS

I. Aircraft (airframe) Production
   - A. Aircraft Drafting
   - B. Aircraft Detail Design
   - C. Aircraft Sheet Metal Construction
     1. Airplane Lofting and Sheet Metal Layout
     2. Sheet Metal Forming, Fabrication, and Riveting

D. Wood and Fabric Airplane Construction
E. Final Assembly and Power-plant Installation

II. Aircraft and Aircraft Power-plant Maintenance and Repair
A. Aircraft Mechanics (Preparation toward CAA Certificate)
B. Aircraft Engine Mechanics (Preparation toward CAA Certificate)
C. Aircraft Instrument Mechanics
D. Aircraft Hydraulic Mechanics
E. Aircraft Electricity

III. Airline and Airport Operation
A. Aëronautical Communication
B. Airport and Airways Traffic Control (preparation toward CAA Certificate Air-Traffic Control Tower Operator)
C. Airline Stewardess
D. Airline Administration

IV. Pilot Training
A. Ground School for Commercial Certificate (including Instrument and Instructor Rating)
B. Flight Training for Commercial Certificate (including Instrument and Instructor Rating)

This list is not intended to be a complete one. It indicates merely the general scope of vocations which fall within the area that junior colleges should serve.

The Committee believes that during the next few years, due to the very large number of trained men who will be returning to civilian life from the armed services or will be displaced from war plants and airplane factories, placement in the vocations of aviation will be rather small. It seems destined to increase, however, and the Committee believes that in at least the larger junior colleges there will be a small need for vocational curriculums in aviation, beginning at once. A wide variety of factors, many of them difficult to predict, are related to this placement situation. Preference will probably be given to veterans in filling positions in aviation, where veterans are available and properly trained. However, a considerable amount of retraining of some of these pilots and technicians will undoubtedly be needed. As for workers who have been employed in the war plants of the aviation industry, the great proportion of them have been trained in "quickie" courses and possess only limited skills. These workers, therefore, to the extent that they remain in the industry, will need retraining in large numbers to broaden their skills and technical characteristics.

The uncertain and unpredictable placement situation in aviation during the years to come points to the necessity of periodic and continuing surveys, which should be made on a national scale. The Committee believes that the

CAA might well be authorized to carry on such surveys, with reports to be made at regular intervals to educational institutions. Only in some such manner as this, we believe, can a serious under-supply or over-supply of trained personnel be averted.

It is also important to recognize in this connection that there is great need for co-operative planning among the junior colleges in California in deciding which colleges will offer which vocational opportunities. This will be taken up at a later place in the report.

*B. Cost*

Education for a vocation in aviation will continue to have a relatively high per student cost. The financing is therefore a problem which must be given careful consideration. Much of the needed equipment is at present obtainable through various Federal sources. Districts can be reimbursed under the California State Plan of Vocational Education for some of the costs of training. The Committee believes that inasmuch as trained aviation personnel is of vital necessity to our nation the proper financing of the training should receive Federal support. Efforts to secure such support should be made. It appears likely to the Committee that some co-operative arrangement can be perfected with commercial airlines and production plants for either scholarships or part-time education in communities where this is feasible. The training of airline hostesses is a further illustration of this, where it is quite probable that the selection of trainees could be made by the airline, which would offer scholarships to selectees, the training then to be done by certain junior colleges. The Committee believes that there is room for a good deal of investigation in this area as a means of helping to bring about some lessening of the otherwise large expense.

It appears obvious that not every junior college should attempt to train for all of the many aviation occupations. The Committee believes very strongly that if money is not to be wasted and great duplication of expense and effort is to be avoided, state-wide planning must be done. We recommend, therefore, that a strong and continuing committee on aviation education in the public junior colleges of California be formed at the earliest opportunity, and we recommend further that the State Department of Education be asked to organize this committee. A legislative provision should be made to enable junior college students to transfer from junior colleges not offering vocational aviation courses to those that do.

The training of commercial pilots is a task that falls well within the range of work for which junior colleges are well fitted. Here again it is recognized that for some time to come there will probably not be large demands for the training of new commercial pilots, as returning service personnel will very likely fill most of the positions. Nevertheless, it is clear that as the years go by, more and more new commercial pilots will have to be trained. The Committee feels very strongly that these pilots will be trained by some sort of institutions

and that it is in the public interest that they should be trained by publicly supported educational institutions rather than by purely commercial concerns. Nevertheless, because of the large amount of flight experience and flight instruction which is required for a commercial certificate, the expense of such training is so large as to be outside the likelihood of fulfillment if borne by either local or state funds. However, it appears clear to the Committee that the importance of such competently and thoroughly trained commercial pilots to the welfare of the nation as a whole, either for peace or wartime, is so great that their training should have Federal support. The Committee is hopeful that there may be authorization for CAA-CPT to sponsor and finance the training of such pilots. These might be selected by a screening process in their preflight or private pilot training and then trained by means of a Federally supported program in the junior colleges. The Committee believes that the California Junior College Federation should take appropriate means to urge upon the government the provision of funds for this purpose, the training of commercial pilots, and should make it very clear to the representatives of the CAA-CPT how very well equipped to take part in such training are many of the California junior colleges.

### ARTICULATION IN AVIATION EDUCATION

Though recognizing the obligation of the junior colleges to accept all students attaining the age specified by law, and the further obligation to take these students where it finds them and to help them attain educational objectives in line with their needs, interests, and abilities, the Committee believes, nevertheless, that there are desirable backgrounds which students might bring to junior colleges.

Illustrative of background courses desirable for those planning to enter aviation vocationally would be (a) courses in high-school mathematics and physics, (b) courses generally labeled preflight, at present, or to be incorporated in the type of course later described here as general aeronautics, and (c) if they can be worked in, enough shop courses to give students at least a general working knowledge of shop practice.

It is felt desirable that high schools should make provisions for students to gain sound guidance concerning aviation as an occupation, including provisions for testing, at least to screen out students clearly unfitted for the field. If this articulation is to be effected, high-school guidance workers must be kept well supplied with accurate, up-to-date information as to the high-school courses which prospective vocational aviation students should take. Of course not every junior college will offer the same vocational aviation curriculums, but state-wide planning can well be fostered by the state-wide aviation education committee already recommended.

The Committee believes, however, that no matter how careful the articulation may be that is worked out either locally or state-wide, there are bound to be, for some years to come, students entering nearly every junior college,

who decide to train for vocational aviation, but have little or no background preparation for it. Therefore, it is believed that junior colleges generally will need to provide background courses, both those of a general nature and those specifically related to aviation, for such students. Even though taking these may require a longer stay for such students before they can enter the specific vocational training which they desire, the situation is not unlike several at present existing, in which some students are penalized upon entering college because of the fact that having made up their minds too late, they have missed needed high-school courses.

### GENERAL AVIATION EDUCATION

*A. Aviation Courses in Junior Colleges*

Rapidly increasing numbers of junior-college students will want, and need, aviation education, not on a vocational but on a consumer basis. Some of these students will have had considerable high-school work in this field, and within a few years some will even have had in high school limited hours of flight experience. Others, and at least for some time this will be the majority, will have had little or no aviation education in high school. The Committee, therefore, believes that for some years junior colleges will need to provide on a purely non-vocational basis for aviation education in the following ways:

1. General aeronautics courses which will cover to a large degree the same ground which some students will have covered in high school. These students obviously should not repeat general aeronautics courses in college, but students not having had them should take them for background. The content of a course in general aeronautics is illustrated by the following outline, suggestive in nature. This particular course is given as a one-semester, three-unit college course.
   a. Aeronautical Industry
   b. Theory of Flight
   c. Principles of Aircraft Operation and Construction
   d. Propellers
   e. Power Plants
   f. Communication and Safety Devices
   g. Instruments
   h. Navigation and Meteorology
   i. Civil Air Regulations

   Worked into the course and permeating it throughout is illustrative material on the social implications of the air age, concerning which more will be said later.
2. Courses dealing with specific aspects of aviation, for junior-college students not vocationally interested in aviation, but increasingly interested as consumers, will need to be offered. These will be particularly for students who have had general aeronautics in high school, and will include such offerings as meteorology, navigation, power plants, civil air regu-

lations, and theory of flight. They would all be offered as electives and would vary appropriately as to time allotment and unit value. It is believed that there will be a considerable number of students so keenly interested in private flying that they will wish to go beyond the general aeronautics course into one or another of such specialized courses. It seems hardly likely that many students will be able to fit more than one or two of these into programs already crowded.

3. It is believed important that flight experience be made available to students taking aeronautics courses. This is not just to give them a thrill, and certainly not to teach them to become pilots. It is, rather, to insure that the principles which they are studying in general aeronautics or special aeronautics non-vocational courses be made real to them through the flying experience. It is probable that as the years go by many students will gain such flight experience up to the limit of perhaps four hours each in high school, for the same reasons. However, many such students will not have had this opportunity in high school, and, particularly for these, it is urged that provisions be made to supply it to them during their junior-college stay.

*B. Education for Private Pilot's Certificate*

The Committee believes that high-school and junior-college students who have learned much about aviation, through content put into many different courses to illustrate the impact of aviation upon the world, through general aeronautics courses, and through specific courses, will not be satisfied merely with a few hours of flight experience. In great numbers they will want to learn to fly. At present it is impossible to say how many private planes will be available, how cheap they will be, or how feasible it will be to suppose that students should learn to fly just as they now learn to drive automobiles.

However, it is entirely clear that a person who is to learn to fly must not be allowed merely to pick up the technique in the hit-or-miss fashion which has been allowed to develop with regard to driving automobiles. The tragedies to society, if such were to be the case, would be altogether too great. There must continue to be many restrictions in connection with qualifying for flying.

The Committee devoted a great deal of thought and time to the question of what agencies should teach flying, that is for private or non-vocational flying, and how it should be accomplished. The feeling was very strong that the training for such private flying must be kept in the hands of public educational institutions, with every effort being made to meet standards such as are now in existence through the CAA. Otherwise, the situation will become chaotic, with large numbers of fly-by-night operators having the minimum provisions for inspection of equipment and qualifications of instructors which the law allows.

It is the Committee's recommendation, therefore, that the training of private pilots, up to the level required for obtaining their certificate, be recog-

nized as an obligation of public education and that the junior colleges as one of the logical institutions to give such training seek, as rapidly as it may become feasible, to provide such facilities as are necessary for adequate flight instruction.

The Committee recognizes that there are many difficulties in the way of this accomplishment and has tried to consider what some of these are. One of the most apparent is the cost involved. Under existing prices the training would require an expenditure of somewhere around $300 a student for the rental of planes and instructors. If the instructor were employed by the college and the equipment were owned by the college, it is thought that such cost might be cut down somewhat, but not greatly. Another difficulty is the likelihood that instructors may give almost sole thought merely to helping the student develop the necessary manipulative skills. The Committee strongly believes that if the full educational values and import of flight training are to be gained, resulting in intelligent operation and recognition of responsibilities as well as mere skills, instructors of high caliber will be necessary. It believes that this objective is far more likely to be gained if the colleges themselves employ the instructors.

The value to the nation of having large numbers of pilots who are trained at least to the level of private certificates is so great that the Committee believes that the government should be urged to make available to junior colleges surplus training planes no longer needed for war-training purposes.

It is to be noted that there will be considerable numbers of students as time goes on who will have already obtained private pilot certificates but who for various reasons of a non-vocational nature will wish to progress beyond this to obtain commercial pilot certificates or the instruments certificate merely in order that their own flying may be less restricted. Here again it is the Committee's belief that the cost of such training would justify itself.

*C. Aviation Content in Existing Courses*

Aviation education is intimately related to nearly every instructional area. The Committee commends to junior-college educators the following quotation from President A. C. Willard of the University of Illinois, "No industry makes such broad demands on so many fields of human knowledge as aviation. These demands range from astronomy and physiology to sociology and zoology; from medicine to engineering; from agriculture to commerce; from law to business management; and include nearly all the sciences. In no other field of technology is the relation between the machine and the human being so intimate and so important. Any comprehensive program in higher education related to aviation must be designed to utilize as many existing departments as possible." It is believed imperative that rapid steps be taken to insure that all students by the time they leave junior college will have a broad vision of the limitless effects of aviation upon society. Illustrative of these impacts would be the following topics, each of which could very easily be worked into the

content of one or more existing courses, either at the junior-college level, the high-school level, or both:

1. Global geography and travel
2. Air transportation and air express
3. Social effects of airplanes
4. Economic effects of airplanes
5. Political effects of airplanes
6. Air laws and regulations
7. Airport operations
8. Air finance
9. Physiological effects of flying
10. Effects of flying on language study
11. Relation of aviation to fine arts and architecture
12. Relation of aviation to vocabulary

In at least the following subject areas or courses (and probably others) the Committee believes that steps should be taken to see that the effects of aviation are included for some consideration:

1. General biology
2. Physiology
3. Courses in general business or introduction to business, stressing economic aspects of aviation
4. Economics
5. General chemistry, with information on structural materials and design
6. Courses in botany, including recognition of possible introduction of insect pests to areas hitherto free from them
7. English, with many implications for vocabulary study and for communication generally
8. Geography, where the content and concepts have been wholly altered by the airplane
9. Physics, obviously with a great number of illustrations and principles related to flight
10. Mathematics, where many problems can be recast to emphasize flight.
11. Social studies, with practically every social studies area affected.
12. Art and music, which are illustrative of areas in which the impact of flying is just beginning to be appreciated

The importance of including much aviation content in existing courses is illustrated clearly when we remember that most students, vocationally headed in directions other than aviation and interested in aviation primarily as consumers, will not have much opportunity to take specialized or even general courses in aeronautics itself. It is pointed out, moreover, that the impact of the air age upon numerous vocational fields is great, and that efforts should be made to see that in each of the existing vocational curriculums where it is appropriate this impact be carefully studied.

The Committee believes that although some of the effects of aviation might be considered in practically every existing course there are perhaps half a dozen key courses or key areas most drastically affected, and that it is in these that the first steps should be taken to insure the incorporation of material on aviation.

Much thought was given by the Committee to means of bringing about inclusion of aviation content in existing courses. One method of accomplishing it would be to have administrators set up faculty projects, *e.g.*, by departments, in which each department of at least the key areas would study cooperatively just what aviation education materials can most logically and conveniently be incorporated. It was the belief of the Committee that this approach would have only limited results. Further consideration as to bringing about infiltration of aviation materials to existing courses appears later.

### THE TEACHING OF AVIATION

If aviation content emphasizing the impact of the air age upon living is to be adequately worked into existing curriculums throughout the public schools and especially on the junior-college level, teachers themselves must understand something about aviation, and must be air-minded. The Committee is thoroughly convinced that the "air conditioning" of teachers will not come about accidentally. It recommends, therefore, that a series of steps be undertaken which comes under the general heading of in-service teacher training.

Members of the Committee who themselves have flown have found from their own experience that one may read about airplanes and the changes in our living which they are bringing, or may hear lectures about them, but that not until one has actually flown and has thus experienced personally the physical shrinking of the globe brought about by the airplane does his knowledge become an integral part of his thinking and living. Therefore, the Conference believes that it is vitally important that steps be taken to aid teachers generally throughout the schools, but teachers especially in key fields of application, to get personal flying experience.

Recently with the co-operation of the CAA there have been held in a number of places what are called "Airport Operation Institutes", usually on a one-day, sometimes a two-day basis. In such institutes selected persons are taken behind the scenes, so to speak, at large airports; they are shown the methods of operation of the control tower; they are allowed to go into and through various types of planes, these experiences being combined with lectures ahead of time and question periods afterward. Usually provision is also made to see that each member is given at least a short flight. Persons who have attended such institutes have found them very valuable for giving new insight and recommended them highly.

The value of making such institutes available to school personnel can scarcely be exaggerated. It is emphasized that not only teachers but school administrators and school-board members might very well profit by such exper-

iences. Therefore, it is hoped that either through the CAA or by other means, more persons may be given this type of opportunity to examine first-hand the operations of modern airlines and airports. The Committee has several suggestions in mind as to how this may be accomplished. One would be, of course, through added support and co-operation from the CAA should that become possible. Another would be that in co-operation with airlines themselves or airport operators, either at private or municipal airports, there might be held somewhat similar types of institute to the one just described.

Such institutes might be set up in local airports where facilities make it a possibility, with school-board sponsorship, and the Committee sees no reason why school boards should not consider attending institutes of this sort as fulfilling the legal requirements for institute attendance. To sum up, the Committee believes that there are a number of ways by which more teachers and other school personnel can rapidly be given first-hand experience with and in planes to the end that their insight and ability to infuse their courses with aviation content may be much enhanced.

The Committee does not believe, however, that the mere attendance and experience at such institutes are sufficient. It is suggested that, following the holding of such an institute under whatever auspices, the faculty which has participated be brought together to see that there is a conservation of the experiences gained. This might well be done by holding local conferences of faculties meeting by subject-matter fields, so that in each area of the curriculum efforts would be made to survey the content appropriate to include in present courses. If these conferences are to be of greatest worth there must be good leadership for them.

This leadership might be supplied from several sources. The University of California Extension Service could help as one source. Another source would be local persons, either faculty members or laymen, who themselves are experts or at least are experienced in one or another of the many phases of aviation. In nearly every school, it is believed that there are already present some persons who have taken part of the ground-school work given under CPT or other auspices. Such sources of leadership must be used to the fullest extent.

As a further step in making teachers air-minded, the Committee recommends an extension of summer aviation workshops, in which for an intensive period of several weeks, groups of people work together on curriculum problems connected with aviation and carry their findings back to their local situation. Another step that the Committee believes can be taken would be the continuing of the CPT ground-school courses, making them readily available to teachers. It is felt important that efforts be made to have local boards of education grant credit under salary-schedule requirements for such courses.

In connection with the holding of local conferences, or other in-service plans for the purpose of conserving the aviation experience of faculty members, it is recommended by the Committee that efforts be made to co-operate

with the many non-school aviation education interests. Among these would be such agencies as the Civil Air Patrol, Civil Aeronautics Administration, National Aeronautical Association, such organizations as the commercial airlines, the aircraft manufacturing establishments, and such club groups as glider clubs, model airplane clubs, and, to some extent, Boy and Girl Scouts. Most of these and many other aviation interests are eager to co-operate with schools.

The Committee believes there should be financial assistance from the Federal government for the preparation of aviation teachers.

Finally consideration must be given to the supply of teachers for vocational classes in aviation. Since this supply is rather limited, and it is at the present time very difficult to get adequately qualified teachers who have had both the vocational experience and training and background that is necessary, and also possess the necessary educational training and qualifications, it is recommended by the Committee that at least one state institution which trains teachers for the college level take steps to become a center for the training of teachers for vocational aviation. It is believed that such teachers ought to go through a curriculum leading to the granting of the general secondary credential, as well as insuring that they are well qualified vocationally.

To sum up the Committee's thought concerning the training of teachers for aviation education, the following steps are set forth and it is recommended that they be taken in every community possible:

1. That institutes illustrating airport operations and including flight experience, be set up and made available to at least key members of college faculties, and that they include administrators and school-board members as well.
2. That institute-attendance credit be given to instructors experiencing such institutes.
3. That in local colleges, following the holding of institutes on aviation, meetings be held by departments to rework courses so as to include aviation content. The vitally important leadership for such conferences may be secured with help from University Extension Service, Civil Aeronautics Administration, or if neither of these sources is feasible, in every community there will be some local persons with some background in aviation.
4. That aviation courses such as the CPT ground-school work be made available to teachers in their local community where feasible, and that credit toward meeting salary-schedule requirements be granted for the completion of such courses.
5. That expansion of aviation workshops in the summer time be undertaken if possible with co-operation from CAA.
6. That at institutes, workshops, and elsewhere, representatives of non-school aviation interests be invited so that there may come about better working understanding between college and non-school groups.

The Committee suggests finally that the California Junior College Federation consider the advisability of developing one of its forthcoming conference programs to aviation education, if possible, holding it in the form of an airport operations institute.

SUMMARY OF RECOMMENDATIONS

1. Junior colleges should offer vocational training in aeronautics.
2. Cost of vocational training in aeronautics should be partially met by Federal assistance (Smith-Hughes and George-Deen Vocational Education Acts) and the CAA Civilian Pilot Training Act.
3. Junior-college vocational training in aeronautics should include full preparation of at least selected students for obtaining commercial pilot certificates.
4. State Department of Education should organize a strong permanent state-wide aeronautical education committee to provide state-wide planning in setting up vocational training programs in aeronautics.
5. Articulation between high-school and junior-college vocational education should be fostered by the state aeronautical education committee and also by local committees.
6. Junior colleges should offer background courses in aeronautics, both general and vocational, for those students not completing such courses in high school.
7. Junior colleges should offer non-vocational courses in aeronautics which would be in the nature of a general aeronautics course probably one semester in length, and carrying three units of credit.
8. Junior colleges should offer consumer-aviation courses with greater emphasis upon specific aspects of aviation science than is contained in the broad general aeronautics course.
9. Flight experience of a laboratory nature, to illustrate basic principles studied in the general aeronautics course, should be made available to junior-college students. This flight experience might include up to a limit of four hours of flight-instruction demonstration for those who did not acquire it in high school.
10. Flight and ground-school training up to and including the private pilot's certificate should be recognized as an obligation of public education, and junior colleges should provide facilities required for safe, well-controlled training when the financial problems involved are solved.
11. As rapidly as possible, aviation education and the implications of the air age should be worked into the content of courses of every subject area.
12. To aid teachers in becoming air-minded, many first-hand contacts with aspects of aviation, including flight experience, should rapidly be made available to teachers. These experiences should be followed, locally, by group planning to modify existing courses so as to include material on the age of flight.

## COLORADO

THE IMPORTANT part that aviation plays in the life of all the peoples of the earth is generally recognized in the schools of Colorado. The airplane has great significance for education both in wartime and in peacetime. The scientific and socio-economic implications of aviation must become matters of increased concern to schools from the kindergarten through the university.

Programs have been proposed for elementary schools, secondary schools, and colleges in this publication. The recommendations here presented have emphasized practical plans for extension and improvement of the work of the schools as they are now conducted. The requirements of students in all subjects and areas of learning have been carefully considered in these recommendations.

The programs of aviation education suggested in this report are the outcomes of the most commendable type of local, state, and Federal co-operation. They are presented to the schools with a hope that they may serve as a basis for the consideration of making aviation education an integral part of their regular educational program.

The State Department of Education wishes to emphasize that no Federal program involving controls or financial aids will be found, and the responsibilities of state and local educators for the success of aviation are accordingly great. Colorado educators will do well to consider seriously all phases of aviation education, since the established school systems may lose the dynamic stimulation of this field of learning if students are forced to look elsewhere for it.

On behalf of the schools of Colorado, the State Department of Education gratefully acknowledges its indebtedness to those educators and consultants who have so ably contributed to the development of the programs presented in this report.

**INEZ JOHNSON LEWIS**
**State Superintendent of Public Instruction**



IN AN AGE in which aviation is creating more profound changes in human living than any invention since the emergence of the Industrial Revolution, it seems absurd to ask—"Should provision be made for aviation education in the schools?" The answer is inescapably "Yes" if they are to fulfill their constant obligation to recognize and attack the vital problems which confront society.

Two years ago, U. S. Commissioner of Education, John W. Studebaker, in his encouragement of a program of aviation education in the schools said, "In building up and maintaining our air power, the schools are called upon for service of prime importance by adding immediately to school-curriculum courses and activities in the field of aeronautics. The need for so doing is

based upon two premises: *first,* the immediate relationship of aviation education in the schools to wartime needs; *second,* the relationship of aviation education to the postwar world."

The world's entrance into the air age has created unique responsibilities for educators. The impacts of aviation have branched out in countless directions, and these trends must be followed and understood by an educational system which is adjusted to the times.

The pressing obligation of schools to educate youth for life in a shifting era is not the simple task of merely re-applying conventional educational procedure. Ultimate adjustment of schools to the air age involves a clear recognition of both the immediate effects of swift transportation, and the long-term adjustments in society to be worked out over a longer period.

The first of these tasks consists of aiding both children and adults to appreciate the fast transportation and communication created by planes. An outstanding example today is witnessed in the development of warplanes.

The adjustments in society present a problem of great magnitude and one that cannot be met in a month or a year. School people cannot measure their plans for air-age education in terms of the present air war. Even now they are seeking perspective and attempting to catch at least the major outlines of aviation's long sweep into the future, for the changes to come may finally be vaster than any yet seen or even imagined, and the air age may well offer a man a challenge so powerful and insistent as to shake his faith in many of his present fundamental concepts. In fact our generation may be forced to a major reinterpretation of our physical world, our key social ideas, and finally our educational plans for youth.

It may appear incredible that a single mechanical contrivance, such as the airplane, could significantly alter man's understanding of the physical world in which he lives and enable him to surmount nature's ancient hurdles,—the oceans, the deserts, the mountains, and the rivers, which through the ages have thwarted him. It may not seem possible that man is at last free to satisfy his urge to move from place to place with the utmost speed and comfort. But the airplane has brought about these changes.

As a consequence, our view of geography has been drastically changed. Planes have lengthened and deepened man's view of the world. The fact of flight has suddenly introduced man to an element in which he had not previously been at home. Prior to the air age, man had spent centuries as an earthbound creature, scarcely more mobile than the majority of land animals. It is true that he early acquired amphibious skills which numerous animals possessed by nature. But whether on land or sea, he remained at the bottom of the ocean of air.

So after ages of two-dimensional life, man has learned within less than a generation to move freely and safely through the air. This step forward has placed him in control of every avenue of transportation—by land, over the

water, and finally through the air. As soon as airplanes attained sufficient mechanical development to fly long distances over any surface—land, water, ice—old bottlenecks of transportation were eliminated.

The great speed and safety achieved by planes perhaps constitute the most profound aspect of man's conquest of the air. In the early seventeenth century sixty-two days were required for the Pilgrims to cross the Atlantic in sailing vessels; just a few years ago the fastest steamship completed the same run in slightly under five days; today airplanes speed over that distance in ten hours, and practically non-stop.

The airplane has brought to mankind the significance of a spherical earth as opposed to a flat earth. For more than four centuries the fact that the earth is spherical has been known but has not been fully appreciated. The oceans and land masses were conceived of as comparatively flat surfaces, rather than rounded sides of a huge sphere. Areas formerly reached by traveling east or west across the land or ocean expanses are now reached by great-circle flights northward and southward. Man has now obtained a truly comprehensive perspective of the world, and is able to visualize and understand the earth as a globe.

Expansive as are the effects of planes on man's concepts of his physical world, they may contribute even more profoundly to his social and community problems. For example, aviation seems certain to affect city planning, location of industries, and future developments in surface transportation.

As America progresses more fully in the air age, we may expect to witness a vast increase in private flying. Whether the "family plane" will finally take the form of a helicopter or something entirely different, we do not know, but the "family plane" will undoubtedly become a reality after the war.

World travel, too, will be greatly affected in the future by aviation. For example, until recently it was necessary to make a trip to an ocean port, often a lengthy journey in itself, before embarking upon an ocean trip. In the air age, points of departure will not be limited to ocean ports, but towns far inland will become ports of departure. Small, isolated communities of today may markedly expand because they will have achieved direct outlets to the world.

Swift passenger service already enables people of many nations to assemble quickly for business or leisure. The linguistic problems created by the presence of foreign visitors in this country, and increased air travel by Americans, will make linguistic versatility necessary. No longer isolated from other nations, we must learn to communicate not only with Latin Americans, but with peoples of all parts of the world. And to converse with them intelligently we shall also need to understand their cultures and *mores,* their social and political philosophies.

The social implications of aviation will need to be stressed in order that planes may not again be turned into a human menace as they were by aggressor nations. This is not the first time scientists have produced devices which

carried enormous social and humanitarian potentialities, only to have them devoted to purposes of destruction. Airplanes can serve the highest ethical purposes; for instance, to relieve the suffering that follows in the wake of plagues, fires, and earthquakes, or to carry medicine swiftly across oceans and mountains.

Thus the educational challenge of the air age has grown complex, insistent, and immediate. Young people require a thorough introduction to the scientific principles which underlie flight. They must learn about the unusual political, social, and ethical issues—local, national, and international—which aviation has raised. The problems of the air age are so urgent that schools should respond promptly and vigorously to a rare opportunity to influence, guide, and shape an emerging era.

Schools cannot escape their responsibility to society. They have responded to the need for aviation education for war. They must also respond to the need for aviation education for peace if America is to maintain a position of responsible leadership in the interdependent world which is to follow the war. The need was clearly stated by de Seversky when he said, "In the days of land power the Roman Empire was strong because every Roman was a soldier. In the days of sea power Britain flourished because every Britisher was a sailor at heart, even if he never went to sea. Now we are approaching the era of air power and if our nation is to preserve the heritage of its free institutions, from now on every American must be, in his heart at least, an airman."

### AVIATION EDUCATION IN THE ELEMENTARY SCHOOLS

The Committee is of the opinion that education can best be served by relating aviation to the total program of the elementary school. The alert teacher will use every opportunity to introduce aviation materials when they meet the *needs* and *interests* of the children. In keeping with the policy of fusing courses, as developed in the state course of study for elementary schools, aviation teaching can be integrated with most of the areas of study in the elementary curriculum.

It is desirable to leave these teaching materials flexible enough to be adapted to individual and group needs, but the elementary school has definite responsibilities in aviation education. It should initiate a systematic plan whereby attitudes, knowledges, and skills in aviation can be developed in young children and continued at least through high school. A child leaving the elementary school should have a vocabulary relating to aviation, a knowledge of elementary scientific and mathematical principles involved in flying, and understandings of the social, political, and economic effects of the airplane.

Most children are enthusiastic about aviation. This interest can be utilized in solving problems motivated by children's questions. If we agree that concepts should be taught children at the times in their development when they are most ready to learn them, the teacher needs to be able to analyze and

appropriately to satisfy children's interests as indicated by their questions. These questions may thus form a basis for the teaching of aviation concepts wherever they fit into the teaching program.

The following sections illustrate the use of questions in the development of problems to be solved by the class. Six of the most common of these problems have been stated for the use of teachers, and Problems I and V have been developed in considerable detail.

Suggested activities and experiences applicable to one or more problems have been listed. These can be used as desired. Large units may be developed from the suggested problems. The problems are intended to illustrate opportunities for adaptation of activities in the different curriculum areas, such as science, social studies, arithmetic, music, and art.

### *Problem I*

*What Makes an Airplane Fly?*

The problem, "What Keeps an Airplane in the Air," is one that arises at all grade levels. Since it is obvious that six-year olds cannot fully understand some of the principles involved as well as twelve-year olds can, it seems that the best way to develop teaching materials is in psychological sequence. Then the teacher can adapt these materials to her own group needs.

The experiences or activities suggested for helping children solve the following problems are just a few of many that may be used. Children themselves will often have ideas for ways to solve their problems. Teachers will find many other activities in elementary-science texts and other sources listed in the bibliography.

QUESTION I—*What Keeps Aircraft Up in the Air?*

Since air is a fluid, first develop:

1. Why Do Things Float in Water?
   a. Develop the concept that air is lighter than water. So anything containing air floats in water.

   Activities for lower grades:

   Try floating different objects in water. Examples—wood, stone, feather, paper, cork, flat pieces of metal, and metal box. Float a dry sponge, then squeeze under water to see air bubbles come out as the sponge sinks. Repeat with a balloon, filling it under water to see air bubbles come out as the sponge sinks.

   Activities for upper grades:

   Fill bottle partly full of water and float upside down in water. Try with varying amounts of air. Weigh an object that will float, such as a block of wood. Fill, with water, a container large enough to float the wood. Carefully place the wood on the water, catching all that overflows in another container. Weigh the water and compare with the weight of the wood, to teach the concept that a floating body displaces its own weight.

2. Why Do Things Float in Air?

a. Develop the concept that air is as real a substance as water.

Activities for lower grades:

Try filling a small-necked bottle with water. Note that water will not go in until the air comes out. Many simple experiments may be found in any elementary-science book to teach further this concept.

Activities for upper grades:

Illustrate that air flows. Partly fill a bent glass tube with water. Blow on one end and see water move around the curve and out the other end as the air pushes it.

b. Develop the concept that things that float in air must be supported by it.

Activities for lower grades:

Drop feathers, bits of paper, milkweed seeds with and without the downy "parachutes" attached. Note that all finally come to the ground. Experiment with soap bubbles and balloons. Observe that they float only when filled with a gas lighter than air or when held up by the wind. Fly kites and observe the difference made by still air and wind.

Activities for upper grades:

Make parachutes of various sizes to see how large one has to be to support a small weight. If a laboratory is available, a balloon may be filled with hydrogen prepared from zinc and hydrochloric acid. Extreme care must be used not to get the apparatus near a flame, as hydrogen is explosive. Since hydrogen is lighter than air such a balloon will float.

c. Develop the concept that a larger surface is supported by air better than a smaller surface of the same weight.

Activities for lower grades:

Drop two identical sheets of paper from the same height at the same time, one horizontally, one vertically. Note the rate of falling. Repeat with one sheet of paper, open and flat, the other crumpled. Push hands against the air flatways and sideways to feel the difference in the resistance of the air.

Activities for upper grades:

Experiment with paper planes, bending wings at different angles to see effect upon fall of plane when dropped.

d. Develop the concept that wedge-shaped objects resist the air less than flat or blunt objects.

Activities for lower grades:

Watch birds in flight. Notice the shape of their bodies and wings. Compare with the human body as to advantages for flight. Put both hands together flat and push the air. Then with them in a wedge

shape; repeat. Watch different kinds of airplanes and compare their shapes with the shapes of cars and boats.

Activities for upper grades:

Construct kites and gliders of different shapes and try flying them. Notice the shapes of different types of planes and discuss their adaptation to their purpose. Compare with birds.

e. Develop the concept that aircraft are constructed as light as possible.

Activities for any grade:

Look at the bones of a bird such as a chicken or pigeon. Note light, spongy structure and wedge shape of breast bone, short tail and light skull. If possible, see a moving picture of the construction of a plane.

**Girls, as well as boys, of high-school age are keenly interested in the study of aeronautics. Here two high-school girls learn about the intriguing and important principles of the glider.**

QUESTION II. *Why Does a Plane Rise When It is Heavier than Air?*

Develop the concept that there has to be a difference in air pressure on the wings of an airplane to make it rise.

Activities for lower grades:

Put a straw in water. Draw a little air from the straw and watch the water rise. Note that unequal pressure of air caused the rise. Do other

simple experiments to clarify concepts of air pressure. Discuss idea that for a plane to rise the pressure below must be greater than the pressure above the plane. Blow across the surface of a streamer of paper held just under the lips to show the lift of a wing.

Activities for upper grades:

Use an atomizer, an electric fan, and the fan of a vacuum cleaner to demonstrate the principles involved in lift. See science books for simple experiments demonstrating Bernoulli's principle.

*Problem II*

*How Do You Fly from One Place to Another in an Airplane?*

Outcomes of this problem should answer questions and develop concepts and understandings of airplane types, use of various types, practices, such as insignia and numbers on airplanes. Develop concepts of what different shaped noses and fuselages accomplish, and different purposes that the position and shape of the wings accomplish.

*Problem III*

*How Are Airplanes Used in the War?*

Gather as much information as possible from various sources which illustrate ways in which aviation has furthered the prosecution of the war from many angles; such as military transportation, mercy flights, introduction of the planes into jungle areas, geographical implications, shortening of distances, broadening of horizons, map study, aviation, and weather. Children of intermediate grades may be interested in studying military uses of planes, such as reconnaissance, bombing, and fighting.

*Problem IV*

*How Will Airplanes Be Used After the War?*

Study the use of airplanes for passengers and freight, the family plane, the new regions that may be opened up, and the need for landing fields on foreign soil. Develop at this point the importance of sympathetic understanding of the peoples of the earth. Show that air travel has brought people of the world into an international and interrelated unit. Study new industries springing from the use of the airplane and its effect on social and economic life, for example, recreation, transportation, and mail service.

*Problem V*

*How Does Flying Affect the Human Body?*

Some of the questions that children may ask are:

1. Why does an aviator black-out?
2. What causes air sickness?
3. What does it mean to have "bends".

To solve these problems children must have some understanding of the circulatory and respiratory systems and their normal functioning. These concepts may be developed very simply by some of the following activities:

1. Let the children put their hands on their ribs and feel them move out and up as they breathe.
2. Children may hold their breath for a few seconds to see how it affects them. Discuss reasons.
3. Feel pulse in throat or at temple when sitting quietly. Repeat after exercising. Notice increased rate of respiration.
4. Look at veins in arms and hands. Hold hands up to sunlight and notice blood vessels.
5. Examine a simple diagram of the circulatory system, and one of the respiratory system. Older children may make a manikin.
6. Discuss the work of the heart, blood vessels, lungs, and trachea.
7. Older children may examine the heart of any animal such as rabbit, chicken, pig, or cow to see the parts.
8. Wrap a live frog or fish in a wet cloth leaving a leg or tail fin exposed. Tie firmly to a shingle with a broad strip of cloth. Stretch the exposed foot or tail fin over a hole in the shingle and mount on the stage of the microscope. The stretched membrane should be above the aperture. Focus under low power and watch the blood flowing through the capillaries.
9. Discuss experiences of the children that have involved change in pressure such as going up and down in an elevator, going to the mountains, or jumping from high places. Explain reasons for the sinking feeling, nose bleed, or the popping ears that they may have experienced.
10. Discuss experiences their fathers or brothers may have had going down in mines or submarines.
11. If the lungs and trachea of a calf, lamb, or pig can be obtained undamaged, a tube may be inserted in a cork placed in the top of the trachea and the lungs blown up.
12. A similar experiment may be done by using a balloon, instead of the lungs. By fastening a cellophane bag tightly around the cork, the affect of varying pressure on the ribs may be demonstrated.

All of these experiences and many others that teachers and children will think of must be supplemented with discussion and reading. Since there is little reading material on a child's level to answer the questions directly, teachers will need to interpret magazine articles and other sources for the children. The bibliography which accompanies this publication should be freely used.

### SUGGESTED EXPERIENCES WHICH WILL HELP TO DEVELOP CONCEPTS AND PRINCIPLES INVOLVED IN SOLVING PROBLEMS RELATING TO AVIATION

1. Take a trip to an airport. Have someone at the airport explain the facilities to the children, particularly weather reporting and how air traffic is regulated.
2. Build model planes; identify planes overhead; use spotter guides, silhouette cards, and pictures of planes.

3. See some of the films about planes which are listed in the bibliography, or suitable commercial films which emphasize flight.
4. Make a puppet plane out of cardboard—strings attached to control stick and rudders and leading to ailerons and empennage.
5. Make a control tower and manipulate miniature planes in accord with the traffic pattern in effect at the nearest airport.
6. Develop vocabulary related to aviation, such as fuselage, empennage, ailerons, wings, propeller, rudder, stabilizer, stick, stall, spin, and glide.
7. Get a copy of a flight plan. Discuss reasons for the information given.
8. Establish a small weather bureau in the classroom.
9. Write air-mail letters to foreign countries.
10. Interview an aviator to learn more about aviation.
11. Interview a hostess concerning her work on a plane.
12. Ask a pilot who has been overseas to talk with children about his experiences.
13. Go to see an airplane. Obtain permission for the children to sit in the cockpit and have an aviator or mechanic explain how the parts of an airplane work.
14. Solve arithmetical problems obtained from aviation situations relating to fuel, oil, mail, express, and travel time between various points in the world.
15. Compare a globe with Mercator and Polar Projection maps. Measure distances on the globe with a string. Notice differences in directions and distances between your town, and Tokyo, Singapore, Moscow, and London as illustrated on the globe and on the two maps.
16. Use aviation literature to provide themes for much written and oral composition; encourage creative writing; write a poem about flying.
17. Teach songs, for example, Army Air Corps Song; dramatize plays written by children about aviation.
18. Develop rhythmic activities based on flying, diving, banking, and others.
19. Discuss international use of airways; use maps and the globe to show international air routes.
20. Sketch and paint various types of aircraft—private planes, commercial airliners, bombers, fighters, and seaplanes.
21. Sketch cloud forms—stratus, cumulus, cirrus. Observe the cloud formations over a period of days and classify the clouds seen.
22. Study main types of camouflage—reduction of visibility, complete concealment, use of decoy targets, and flood lighting.
23. Consider the use of airplanes for family transportation.
24. Make a study of the various workers who are needed by the airplane industry.
25. Study the commercial importance of the possession of landing fields or landing rights abroad.

26. Draw great-circle routes on Polar and Mercator projection maps and compare with the same routes as shown by a piece of string stretched over a globe. Notice that the great-circle route is not a straight line on the Mercator map. Explain.

## AVIATION EDUCATION IN SECONDARY SCHOOLS

### *I. Purposes*

Aviation education came into the American secondary-school[1] curriculum almost over night as a direct result of the war with its unprecedented demand for air manpower. From a handful of secondary schools in 1941-1942, the number of schools teaching courses in aviation skyrocketed in the 1942-1943 school year to many thousands. From a few hundred students, the enrollment of youth in these courses within one year increased to more than a quarter million. No course ever before moved as rapidly into the curriculum of the American secondary school. Aviation education came into the school with the drive of military necessity. Now that the air manpower demands of the war program have been met, is the need for aviation education in the schools removed? The answer obviously depends upon whether education for peace is as important as education for war.

With the winning of the war the primary purpose of aviation education will shift from wartime objectives to peacetime objectives. Instead of the concentration of aviation education for the preliminary education of air-crew personnel for military service, the objective now becomes broadened aviation education for all youth because all youth will inescapably live in an air age which will profoundly affect their daily lives. The first objective of aviation education is therefore general education.

In the early 1900's it would have been fantastic and unbelievable and someone predicted that by 1940 there would be thirty million motor vehicles and forty million licensed drivers in the United States. Today a comparable prediction of the number of aircraft and licensed pilots in 1980 would sound equally fantastic. The future development of private and commercial aviation remains to be seen but it is not unreasonable to assume that a considerable proportion of the population will be engaged in flying, privately or commercially, in the manufacture and servicing of aircraft, and in the control and direction of air transportation. The school has an obligation to them which extends beyond general education for intelligent living in an air age to provide specialized preparation to engage more directly in aviation. Thus the school has additional objectives in providing intelligent guidance, actual flight training, and the preliminary background for engaging in the many vocational opportunities which the postwar aviation industry will present.

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[1] The terms "secondary education" and "secondary school", as used in this report refer to the junior high school, the senior high school, and the junior college areas collectively, grades seven through fourteen.

*II. Aviation Education in the Curriculum*

Traditionally, new curriculum responsibilities of the secondary school have been met by the adding of new courses. This procedure has resulted in the creation of so many courses that even by the alternating of courses it is impossible for any except the very large school to offer most of the courses which have been developed. It is also impossible for the student within the period of secondary education to enroll in more than a few of them. Eventually the situation will demand a thorough revision of the secondary-school curriculum, the identification of those experiences which are socially and individually necessary and desirable, and the discarding of a multitude of antiquated or otherwise superfluous courses.

*III. Infiltrating Aviation Education Into Existing Courses*

An adequate program of general aviation education could be provided by the infiltration of aviation-education objectives, experiences, problems, and materials into existing courses in the social studies, science, mathematics, literature, arts—in fact, few existing courses are not susceptible to vitalization and enrichment by the inclusion of aviation problems and content. It is, therefore, recommended first that every effort be made by the schools to introduce aviation education into existing courses and activities in those situations in which the aviation content would vitalize and give increased significance to the content and activities of those courses. Such procedure meets the difficult problem of grade placement of aviation problems and content by providing for appropriate experiences at the time when they are needed, when they are most meaningful, and when they make their greatest contribution in the total education of the individual. Reference to the materials in the bibliography which accompanies this report will provide teachers in the social studies, arts, science, literature and other curriculum areas with countless illustrations and suggestions of aviation problems and content relevant to their fields.

*IV. The Incorporation of Planned Units on Aviation Education Into Existing Courses*

The infiltration of aviation materials into existing courses can be facilitated by deliberate and planned provision. Units of aviation-education experience may be planned and definitely assigned appropriate time and placement in existing courses. For example, units on air-age geography may be provided for in social studies courses at one or more grade levels, a unit on the implications of air transportation for health in general science or biology, a unit on the implications of aviation for international relations in world history or American history, meteorology in science, aircraft engines and radio communication in physics, aircraft design and structure in arts. The development and specific provision for the incorporation of such units into existing courses is recommended by the Committee as a second long-term method of making provision for general aviation education. It must be recognized, however,

that the incorporation of such units into existing courses which are elective and selective does not provide opportunity for all students to participate in such incorporated unit experiences.

*V. Articulation*

The infiltration and incorporation of aviation education into existing courses which are recommended throughout the school program, even in schools which offer separate courses in Social Aviation and the Science of Aviation, present a potentially serious problem in articulation. It necessitates a high degree of co-operation among teachers so that none will assume that someone else is making provision for certain aspects of aviation education when he may not be or so that two teachers at the same time in two areas of the program or at different levels of the program may duplicate each other's efforts without either knowing about it.

To avoid blank spots or excessive duplication it is suggested that all teachers within a school unit discuss provision within the unit for aviation education so that the complete picture will be seen and understood. This would be particularly important in a school program in which separate courses were offered. It would be conceivable that, if all other teachers decided to incorporate all appropriate aviation education into their respective courses and activities, the specialized courses might be almost complete duplication. The various units within a school system should understand what the other units are doing in aviation education, *e.g.*, the junior high school should be acquainted with the programs in both the elementary school and the senior high school.

*VI. A Course in Social Aviation for All*

Another way to introduce general aviation education into the curriculum is to develop a new course to be included in the school curriculum. Until such time as teachers in the various curriculum areas are able adequately to enrich existing courses by the incorporation of aviation-education problems and content, it is recommended that a separate course in Social Aviation be added to the school curriculum.

The course in Social Aviation should give major emphasis to the social aspects of aviation and minor emphasis to the scientific and technical aspects. Since not all students will be enrolled in the specialized Science of Aviation course which is recommended later in this report, Social Aviation should include meteorology, aerodynamics, and the other science units, but the treatment should be with reference to general-education values and not the technical values. It should be regarded as a part of the social studies program, and should be made available as early as the tenth grade. It may be one year in length at the successful completion of which the student would be granted one unit of social studies credit, although the offering of an abbreviated one-semester course may be more easily placed in many school programs and

would be desirable experimentally in determining what the ultimate length of the course should be. Whether one or two semesters long, the course should be elective. Because of its general-education value, all students should be encouraged to enroll in it some time during the senior high-school period.

The offering of the Social Aviation course does not diminish the desirability of moving aviation content into other courses although it would place some limitation on the scope of such procedure. This problem has been considered in the section above on articulation.

*VII. The Science of Aviation*

Provision should be made in the curriculum for a full-year course in the Science of Aviation which has become established earlier under the title Preflight Aeronautics or the Science of Aeronautics. This course should not be regarded as a general-education course but should be planned for those youth, both boys and girls, who have real interest in the field of aviation, who have purposes intimately associated with aviation and who have the ability to profit by a full-year course concerned with aviation science. This course should be grade-placed not earlier than grade eleven.

The Science of Aviation should be taught as a laboratory science and should be so recognized by colleges with reference to college-entrance requirements. With the availability of surplus and salvaged aviation equipment there is no longer reasonable excuse for any school engaged in the teaching of the Science of Aviation to attempt to do so without real equipment. Much laboratory equipment for the study of aviation can be constructed by the school at little cost. As a laboratory science, the Science of Aviation should meet the standard requirements of laboratory courses with reference to time allotment. Schools having short class periods should be encouraged to change to the longer-period class schedule. The segregation of laboratory and class lecture—recitation activity as illustrated by the three-day single-lecture-recitation period plus the two-day double laboratory period weekly schedule pattern should be discouraged.

Although eligibility for enrollment in the Science of Aviation and equivalent courses in most states involves the completion of certain prerequisite courses chiefly algebra and geometry and, less frequently, physics, such prerequisites are not recommended. This recommendation is no reflection on the value of such courses but rather a reflection of the fact that only a small part of such full-year courses is basic to the study of aviation science. It is reasonable to assume that the necessary skills and understanding which are essential in the study of aviation science may be taught and learned more economically and effectively in situations in which they are more meaningful and in which their need is recognized. Students who plan to continue their education at the college level in the field of engineering should, of course, be encouraged to enroll in such basic courses, since their purpose is different from the purpose of most students enrolling in the Science of Aviation.

The content and distribution of time to the various parts of the Science of Aviation course should be carefully evaluated. There is considerable agreement that the course as developed under the title of Preflight Aeronautics (1) places too much emphasis on certain areas, *e.g.*, navigation, (2) includes some impractical content which should be minimized, and (3) neglects to give adequate recognition to the social and vocational implications of aviation. These same criticisms might be appropriately applied to many other courses. No effort should be made to freeze the content of this course at this time as further experience in the teaching of it and further clarification of its purposes are desirable.

*VIII. Aviation Education in the Smaller Secondary Schools*

Size is recognized as one of the restrictions on many secondary schools in expanding their offering to include the course in Social Aviation and the Science of Aviation. This restriction is particularly significant in Colorado because a large proportion of Colorado secondary schools are small schools. In these small secondary schools it is probably most feasible to provide for aviation education by the infiltration of aviation content or through incorporation of instructional units on aviation.

The alternating of courses which has become general practice with reference to certain established courses offers one solution. If Social Aviation is offered, it could be alternated with world history at the lower levels or with modern social problems at the higher levels of the senior high school, unless these courses are already on an alternating basis. A second possible procedure for adding particularly the Science of Aviation which required much more specific teacher preparation is for two or more adjoining school districts to employ one well-qualified teacher who would work in all the co-operating schools. This practice established by the vocational programs would be worth considering as a means whereby the smaller secondary schools could co-operatively have the services of a well-qualified teacher in the teaching of the Science of Aviation. There are other procedures such as correspondence study which may be employed by the smaller schools which will enable them to provide more nearly the opportunities of the large schools while still enjoying the advantages of the small school.

*IX. Aviation Education in the Junior High School*

The methods of infiltration and incorporation of aviation education into existing courses and activities in the junior high-school program is probably the best way to make provision for aviation education at that level.

*X. Aviation Shop and Vocational Training*

Since the justification of specific job training is conditioned by the employment demands of industry for trained personnel, the needs of industry should be carefully studied by any school engaged in or proposing to enter into a program of aviation shop training. As the war manpower needs in industry are met, the demand for such training will probably be largely eliminated.

The termination of the war will release thousands of persons for civilian aircraft production and servicing thereby minimizing the demand in the years immediately ahead for newly trained workers who are now in school. For these reasons vocational training programs should be careful not to overexpand and the emphasis should probably be shifted from specific job training to a more general type of training which would equip the individual to make an easy and satisfactory adjustment to a variety of related activities with which he may be confronted.

This point of view should not be interpreted as discouraging programs for the general vocational education of youth which, of course, should be encouraged as providing reality and supplementary enrichment of the experiences of the student in the classroom.

*XI. Flight Experience*[2]

It is not recommended that the schools at this time engage in a program of flight training terminating in the qualification of students for the private pilot certificate. The permanent committee which will be appointed to continue the study of aviation education should study the problems of flight training and make necessary recommendations as the need arises.

*XIII. The Determination of the Content of Aviation Education Courses*

While still in the early stages of the development of aviation education, no attempt should be made to standardize content or methods except to insure desirable minimums such as the provision that the science of aviation be a laboratory science. Each school and each teacher should be encouraged to exercise initiative and imagination in trying out new approaches, new content, and new procedures. Only in this way will it be possible ultimately to determine what is best in different learning situations and for different purposes.

It must be recognized, however, that the typical teacher in the typical school may be handicapped by both inadequate background and insufficient time to engage extensively in curriculum building. For that reason it is suggested that the State Department of Education use its facilities to call to the attention of and to distribute to the schools materials which are developed by such agencies as the Civil Aeronautics Administration, commercial airlines, and other state departments of education which are engaging in pioneer work in the field of aviation education.

*XIV. Colorado Committee on Aviation Education*

A permanent committee, appointed by the State Superintendent of Public Instruction, should be established to continue the study of aviation education in the schools. This committee should be representative of all types of Colorado schools. Local, state, and Federal agencies which can contribute to the work of the committee should also be represented. The function of this com-

[2]For the outline on flight experience as laboratory work, the reader is referred to the Illinois program found on pages 30-36 of this publication.

mittee which should meet periodically would be to formulate and recommend policies, encourage schools and other organizations to prepare materials (units, outlines, and bibliographies) for distribution, and to engage in the development of courses or outlines of study.

*XV. Co-operation with Non-School Agencies*

The efforts of the school to provide aviation education opportunities for youth should be supplemented by the services of non-school agencies such as the Civil Air Patrol and others provided such supplementation is under conditions acceptable to the school and consistent with the program of the school.

*XVI. Qualifications of Teachers*

The qualifications of teachers of aviation education courses should be in accord with the standards of the employing school. No attempt should yet be made to standardize the qualifications although it would be desirable for the teachers of both Social Aviation and Science of Aviation to have appropriate courses at the college level. The securing of flight experience and flight training should be encouraged for all teachers engaging in the teaching of aviation courses. School administrators should urge teachers or prospective teachers of aviation courses to secure such experiences and preparation in summer-session college courses if they have not already had such experiences and courses or the equivalent.

*XVII. Opportunities for Aviation Education for Teachers at the College Level*

Aviation education in the schools cannot reasonably be expected to advance much more rapidly than the qualifications of teachers. It is, therefore, desirable that colleges and universities engaged in the preparation of teachers make adequate provision for in-service teachers in summer sessions and for pre-service teachers in regular year programs for courses and experiences which will provide adequate background for the teaching of aviation education in the schools.

*XVIII. Annual Meeting of Teachers of Aviation*

The Colorado Education Association should be requested to make provision in its annual program in the various divisions of the state for a half-day session to be devoted to the problems and interests of teachers of aviation in the schools, especially for teachers of the separate courses in Social Aviation and Science of Aviation.

AVIATION EDUCATION IN COLLEGES AND UNIVERSITIES

The Committee makes the following recommendations for the colleges and universities of Colorado:

1. That colleges and universities have as their three principal aims in offering aviation instruction:
   a. The incorporation of aviation material in all courses where it is applicable, such as in physics, mathematics, and social science, as an integral part of the general-education program of the college.

b. The development of teacher training courses which will not only train teachers of aviation, but also give the fundamental background material in aviation to all teachers in training.
c. The technical training for semi-professional vocations in aviation, such as commercial pilots, hostesses, traffic control operators, and the like.

2. That colleges and universities accept aviation science in accredited high schools as a laboratory science for entrance, the specific entrance requirements set up for engineering and other technical schools not to be affected thereby.
3. That work in the field of aviation be included in the adult education program.
4. That by agreement between interested parties or otherwise all educational phases of the program, as distinct from regulation, inspection, and the like, be under the control and supervision of the college.
5. That provisions be made for flight scholarships to enable persons of high-school age and out-of-school youths to qualify for the private pilot license.
6. That special courses be given for the training of ground-school, flight, and mechanics instructors for colleges and flight schools.
7. That conferences of an educational nature be conducted from time to time for elementary- and secondary-school teachers and for technical aviation personnel.
8. That provisions be made for a library service of visual aids, laboratory equipment, and printed materials for exhibit and classroom reference.
9. That in special or existing courses particular attention be given to the international aspects of aviation, including such matters as aeropolitics, international law, educational conferences, closer scientific collaboration among nations, and other activities designed to promote international cooperation.
10. That, at least for the time being and until other courses are more fully developed with respect to aviation, a general-education course in aviation be offered by colleges for teachers of secondary schools.
11. That consideration be given by colleges to the granting of laboratory credit for flight instruction in accord with standards used in assessing the value of other laboratory work taken in connection with approved classroom and library work.
12. That consideration be given to the establishment of a state-wide committee on aviation education, encompassing the interests of primary schools, secondary schools, and colleges in aviation education.

## CONNECTICUT

AT THE TIME of Pearl Harbor, America had relatively few pilots, navigators, or bombardiers. In less than three years, our American ingenuity and resourcefulness have enabled us to produce all the personnel required to fight a total war successfully. Considerable credit must be extended to the Civil Aeronautics Administration.

The Civil Aeronautics Administration has been largely responsible for the widespread interest in aviation and for the pre-flight training of thousands of young men. This program, conducted through constituted educational channels, has been of the utmost consequence in fulfilling our training obligation for total war.

It is apparent that the influence of aviation on civilian life will be tremendous. There is no barrier to flying anymore, for planes span the Atlantic, the Pacific, the jungle areas, at intervals of minutes. No longer is there anything spectacular about such a trip. We have a major job on our hands in this country in preparing youth for the air age. The Connecticut State Department of Education has prepared this document in order that the schools and colleges of the state may have a guide toward the better understanding of aviation science and the better training of youth for participation in the air age.

The concepts in this report are the product of a committee though full credit belongs to Miss Mary Louise Aiken, teacher in Sedgwick Junior High School, West Hartford, for its production. Dr. Edgar Fuller of the Civil Aeronautics Administration has rendered invaluable service not only in the production of this document but also in advising with the Department and the committees.

**ALONZO G. GRACE**
**Commissioner of Education**

IMPROVEMENTS in transportation facilities have been accompanied throughout world history by far-reaching changes in the political, economic, and social structures. Sailing ships resulted in explorations for new trade routes, which in turn created new markets and brought exchanges of ideas and conflicts between peoples.

The railroad in the United States encouraged the expansion and development of a vast nation, the growth of commerce and industry, and brought the forty-eight states within a four-day reach of one another.

The automobile made possible inter-city bus traffic and private automobile traffic over routes previously untouched by rail. There was an increase in social and pleasure travel and freight transportation. The automobile created many enterprises, brought with it many advantages, and also some problems. Automobile safety education became a major need before educators realized it, and thus far has been inadequately presented to the American public.

Now the airplane makes possible travel in a medium that knows no physical barriers. It reduces a three-day train trip or a five-day ocean voyage to a ten-hour flight. Again a new mode of transportation creates traffic. The airplane increases the market range of a product. Perishables that formerly had only a local sale may now be delivered within hours to a distant market. The factory located in a small town with poor railroad facilities may now have its own landing strip from which its products may easily reach any of the great airports of the world. Air travel for business and pleasure will increase, and a great expansion of commercial transportation and private flying is certain.

International air commerce will bring us more closely to our world neighbors, and we will need a broader understanding of their cultures in order to deal intelligently with them. It is going to require careful study, foresight, and vision to develop wise international policies, to exert good judgment in industrial and municipal planning, and to enact sane and practicable regulation of air traffic at home and abroad. If we assume the responsibilities that are ours in the family of nations, and realize the potentialities of aviation through our capacity for production and leadership, we have a glorious opportunity to make world peace a certainty.

American education has a definite responsibility in the aviation program. It must prepare youth to understand the social significance of the airplane, to participate in the development of air commerce and private flying, and to meet the social, economic, and political complexities of the air age.

Believing aviation is such a dynamic force in the development of world unity and also aware of the implications of its contributions to industry, commerce, recreation, and travel, the members of the Connecticut Conference on Aviation Education recommend the following program[1] for consideration by Connecticut schools.

### AIR-AGE EDUCATION IN THE ELEMENTARY SCHOOLS

Air-age education in the elementary schools should give children basic understandings of the airplane and how it may be used to help them, knowledge of the main parts of the airplane, the types of aircraft, how the airplane flies, its private and public uses, and an introduction to the use of the airplane in relationships with our world neighbors.

The Connecticut Committee on Aviation Education believes the air-age education program for elementary schools to be an integral part of the total education program. This program should be viewed as an opportunity to develop functional learning. In re-evaluating the aims and content of the elementary curriculum, the Committee believes the dynamic value of aviation material should be emphasized. There is no desire to teach aviation as an additional subject, but much may be taught about airplanes in connection

[1] **Prepared for the Committee by Mary Louise Aiken.**

with subjects and units of work already being presented. The social, economic, and political implications should be pointed out wherever they occur.

The airplane has raised questions of a scientific nature in the minds of elementary students which they demand be satisfactorily answered. The importance of the teacher's attitude toward these questions cannot be overestimated. In some cases the child and the community are more aware of aviation than the teacher. It is important that the teacher be interested and well-informed in order to meet the needs of the child.

At each grade level it is necessary to present air-age materials which are adapted to the needs, interests, and abilities of the individuals of that level. This requires discriminating thought on the part of the teacher, for questions on several matters may be raised in quick succession. Such local occurrences as a hurricane or hailstorm presents a learning situation in weather which should not be ignored. Children will ask why and how an airplane flies, why a flier must have oxygen at high altitudes, how the aviator finds his way over uncharted waters, and how far and fast we may fly to foreign lands after the war. They will not always be careful to ask these and many other questions in logical order. It is the individual teacher's responsibility how and to what extent those questions can be answered.

On the initiative of the teacher, aviation materials may be used to good advantage in supplying interest for work in arithmetic skills, spelling, reading, vocabulary study, and purposes of remedial work. The social, political, and economic problems of the air age, which are less likely to be raised by children than the questions about airplanes, may be introduced by the teacher in connection with discussions of airplanes. The uses and limitations of various maps, charts, and globes may also be taught, for the geography of the world of air travel is not the geography of yesterday's textbook.

The Committee feels that elementary aviation material need not only be presented in units and at specified times, but also that it should permeate many learning situations. Air-mindedness should color, but should not dominate, the elementary curriculum.

The group earnestly recommends that careful study of the curriculum be made at the different grade levels in the local elementary schools and elsewhere, and that materials on aviation and its implications be developed and made available to teachers throughout the state. These materials should be developed by the faculties of the local schools, by college and university workshops, and by the State Department of Education. The latter should be the active distributing agency for all materials developed on the state and Federal levels, and should keep the teachers informed on new publications and films as they are released. Colleges and universities should offer pre-service and in-service instruction to develop well-informed teachers. Bibliographies with annotations on books, films, pictures, and printed materials should be used in connection with the work.

The following are some problems for study, activities, and experiences which are recommended for consideration in elementary schools. This list is arranged to suggest the order in which air-age activities might be presented to the child from his earliest school experiences through the elementary grades. The teacher may select those which meet the needs of the particular groups. Many of these may be classified and adapted to pupils of the various age levels of school.

1. Take a model of an airplane and identify the main parts: body or fuselage, wing, engine, propeller, tail, and other parts, so that proper oral and written vocabulary can be used in language activities.

2. Build an airplane six or eight feet long out of crates or cardboard boxes.

3. Build a table airport with hangar, terminal, control tower, and other facilities, as a means of stimulating interest in aviation and providing for dramatic play.

4. Encourage interest in observing the flights of birds, seeds of dandelion and milkweed, kites, balloons, and leaves gliding to the ground.

5. Observe that wind is air in motion (set in motion by fanning the air). Have the pupils make pinwheels, bubble pipes, wind socks, and vanes to observe wind direction.

6. Observe that wind may be helpful or destructive to man, such as clothing drying on the line in the wind, windmills, trees blown over in a strong wind. Observe that wind may help or hinder flight, and discuss the third dimension in connection with the effects of headwinds and tailwinds.

7. Have the pupils write and collect stories and poems about the wind.

8. Build and fly paper gliders (put paper clip on the nose of the glider for better control, and it will rise slower).

9. Make a parachute out of a handkerchief by tying the four corners together with a weight and watching it fall. Then let the weight fall without the handkerchief and have the pupils note the difference in the time of fall.

10. Encourage interest in planes flying overhead. Identify them.

11. Learn the different types of aircraft, balloons, parachutes, dirigibles, gliders, helicopters, autogiros, landplanes, seaplanes, amphibians. Have the pupils differentiate these by the large parts, noting that the helicopter has no wings, the airplane no rotor blades.

12. Have class discussions on what makes an airplane fly, giving simple principles of flight, lift, drag, thrust, and gravity.

13. Encourage picture collections. Use the exhibit to show how the airplane has changed in design in the last four decades, to give children an idea of what flying is like, to show airport scenes, to show the different workers such as the pilot, the stewardess, the ground mechanic at their jobs, and to record certain aviation history facts.

14. Read stories about airplanes, airplane parts, and trips in private and commercial airplanes.

15. Use movies about airplane trips, such as those listed in the bibliography of this publication.

16. Share personal aviation experiences with the group. Perhaps one of the group has made a trip on a commercial air line. He can tell about buying the ticket, going through the gate, going aboard, being greeted by the stewardess, the baggage service, and meals. The group may wish to discuss these experiences. They may wish to gather material for original stories and a dramatic play.

17. Make a list of aviation terms as the pupils learn them, and thus develop their own aviation dictionary.

18. If possible, take the pupils to an airport or to a museum of aviation material.

19. Learn how airplanes help us by carrying passengers and air cargo. Discuss the kinds of air cargo: mail, emergency repair material, emergency medical supplies, and perishables. Have pupils find the novel uses the airplane may have, such as the use made by the suit and coat manufacturer who hung suits and coats on hangars in an airplane to eliminate packaging and pressing. Note the expansion possibilities of air cargo.

20. Have a report on the Mars cargo plane or a similar plane, and consider the implications of the use of such a plane.

21. Encourage talks on different phases of air transportation, such as private flying, commercial flying in the United States, and flights to other countries.

22. Dramatize news stories on air transportation.

23. Note the health and safety measures taken by the commercial airlines: health requirements for pilots and stewardesses, safety belts for passengers and crew, air conditioning and extra oxygen supply, the limited rates of climb and descent, the cleaning of the airplane and the elimination of disease-carrying insects, after a flight, the maintaining of altitude on North or East flights at odd thousand feet and on South or West at even thousand feet to prevent collisions.

24. Teach the principal air traffic regulations for safety in flight traffic, how they are made by the government, and why they are necessary.

25. Have the pupils compare the costs and time of passenger and freight by automobile, truck, ship, train, and airplane.

26. Study the history of air-mail transportation. Compare the time and cost for mail delivery by airplane with that of other means.

27. Draw a map showing surface and air transportation lines converging on your town with locations of railroad stations and nearby airports.

28. Construct a model of the airport in or near your town. Compare with sketches of other airports, landing strips, or seaplane bases.

29. Show on a globe or polar projection map the principal air routes from United States to other countries in the world.

30. Have a polar projection map drawn, showing air routes from your town to some of the world capitals. Discuss the limitations of this map for air navigation and why the Mercator map is in common use for this purpose.

31. Construct a graph showing the time required to travel from New York to San Francisco by automobile, train, ship, and airplane.

32. Compare the cruising speeds of different types of airplanes.

33. Measure wing areas on the corridor floor.

34. Consider the convenience and problems of private plane flying, commuting to business from the suburban home, flying to one's favorite fishing or hunting ground, vacation trips, and similar situations.

35. Acquire data on private planes—cost, upkeep, licensing, and other items.

36. Learn how the airplane has been used in exploration.

37. Learn of the use of the airplane in forest and coastal patrol, photographic surveying, dusting cotton and other crops, mosquito control, and other projects.

38. Show some specific ways in which the airplane has already changed our mode of life, and its effects on living conditions in some heretofore remote areas (as for example, certain parts of South America, Canada, Alaska).

39. Study time-zone changes and calculate time at different places in the world. Make imaginary trips around the world from East to West and West to East, noting the time changes.

40. Discuss materials used in building airplanes, where they are found. Get samples if possible and prepare an exhibit of materials.

41. Encourage pupils to build models to an extent determined by interest and ability.

42. Learn about the atmosphere, air pressure, effects of heating and cooling air, and the relation of these to flight.

43. Develop some elementary ideas about weather and weather forecasting.

44. Lead pupils to appreciate the importance of weather to the pilot.

45. Tell legends and stories of early flights: Daedalus and Icarus; Leonardo da Vinci's plans for a helicopter, glider, and parachute; the balloon of the Montgolfier brothers in Paris in 1783; and the observation balloons of the American Civil War.

46. Discuss the glider flights of Cayley (1809), Lilienthal (1891), and Chanute (1896).

47. Encourage pupils to become acquainted with certain historic airplane flights: Wright brothers (1903), Ely's flight from the deck of a U. S. cruiser (1910), the first airmail (1911), airplanes used in war (1914), Alcock and Brown's trans-Atlantic flight (1919), Byrd and Bennett's flight over the North Pole (1926), Lindbergh's New York to Paris flight (1927), Howard Hughes' global flight (1938), and his transcontinental flight in the Constellation in less than seven hours (1944).

48. Have pupils read biographies or articles about men who have contributed to the progress of aviation, such as: Wright brothers, Mitchell, Trippe, and Douglas.

The preceding suggestions give only a few of the many opportunities for air-age education in the elementary schools. However, they indicate how the child may gain a general background for the air-age, and how he may obtain certain basic understandings of the airplane and its implications for society. There are an increasing number of teaching aids available in this field, and teachers are urged to consult the bibliography of this publication and other sources.

### AIR-AGE EDUCATION IN THE SECONDARY SCHOOLS

This section relates to the effects of the air age on all studies in the secondary schools which do not deal directly with aviation. The reasons for incorporating air-age materials on the secondary level are the same as those supporting the use of air-age materials in the learning areas of the elementary schools. Appropriately used, these materials enrich and modernize the study of such subjects as social studies, sciences, mathematics, languages, and arts and crafts.

Air-age education is far more than the learning of some facts about the airplane or the scientific principles which explain its development. True, the social, political, and economic effects of the air age are best understood when the learner knows about the science of aviation and has practical knowledge of flight, but these facts may be acquired without an appreciation of what they signify for society. The teachers of non-aviation subjects in the secondary schools must themselves learn enough about aviation so that they can make the social results of the air age authentically clear in connection with the teaching of their various subjects.

In a society which has grown increasingly complex, the responsibilities of the secondary schools have become increasingly important. Many students receive their last formal education in the secondary school, which must therefore complete their preparation for good citizenship. Some of these problems of citizenship have resulted from the advent of the airplane, and serious problems for the future lie clearly in view. The adult of tomorrow needs preparation that he may understand the social significance of the airplane and make the most of the opportunities which the air age offers.

Students must become aware of America's responsibility in the family of nations. At the conclusion of World War II the United States, through her productive capacity and leadership, will have the opportunity to present and support policies which will encourage the maintenance of peace. We must prepare the younger generation to understand policies relative to airways, air bases, communications, and regulations both nationally and internationally. The aviation industry must solve wisely its problems of research, design, and production if it is to be preserved as the basis of the air-age activity of a great nation. There must be education which will encourage a vast expansion

of private flying and services in air cargo and passenger transportation; all these for national safety in the world of the air and for the maintenance of our national leadership in aviation as well as for their social benefits.

In order to develop fully the potentialities of the air age, the public must appreciate the significance of the airplane. Knowing the facts, the public will realize the significance of the relative costs, the relative safety, and the economy of time of air passenger and cargo transportation. There is a great future in air transportation which alert business men are beginning to realize, and this augurs well for our country. Preparation for and undertsanding of this air world is an important function of the educational program in general.

One phase of the development of air transport is the planning and construction of new airports. Straight, L-shape, or T-shape landing strips, airports, seaplane bases—which one answers the needs of the particular community? Problems of cost of construction and maintenance must be solved. Choice of location is all-important to the flyer and to the community. Favorable physical characteristics to insure good landing and take-off conditions and accessibility of the airport to the community and surface transportation facilities must be considered. The boys and girls who are now in the secondary schools will construct, operate, and pay for a tremendous airport development during the next fifty years. They should begin to study the problems inherent in such developments.

An industry in a small community may have a restricted market because of poor surface transportation facilities. When that factory has a landing strip, its product may suddenly become available to a world market. And thus may arrive opportunities for the decentralization of industry and the development of suburban areas. Students should be aware of these impending economic changes.

In a world at peace, aviation offers a mode of transportation ideal for world travel. Plans for a two-week vacation are no longer greatly limited by distance. Already the sportsman flies to his favorite fishing or hunting ground. One of the greatest potential developments can be found in the possible recreational uses of the airplane.

The prospective vocational opportunities in aviation are appropriate for high-school teaching and guidance. The school should exercise great caution when giving vocational advice in the field of aviation, and the occupational information about aviation should be realistic. For example, a reduction in aircraft production is to be expected at the end of World War II. The present number of aeronautical engineers may not be maintained. However, expansion of civilian air transport will increase the number employed in sales and service.

The school should have as accurate information as possible concerning the supply of and demand for jobs in aviation, and when advising students, it should consider the backlog of trained personnel to be released from the mili-

tary air forces. Most students will fly as private citizens and earn their livelihoods in non-aviation pursuits, but this is no reason why they should not study aviation and its implications for society. Only a few high-school subjects are for specific vocational purposes; air-age education is essentially general education and non-vocational in content.

Some of the occupational possibilities which can be discussed are: air-traffic controller, aeronautical engineer, aeronautical inspector, transportation salesman, publicity employee, advertising employee, manager, ticket agent, clerk, reservation- and space-control agent, service mechanic, instrument mechanic, radio-maintenance man, stock clerk, fleet-service clerk, fleet-service cleaner, meteorologist, pilot, stewardess, flight radio operator, director of communications, teletype operator, accountant, auditor, business-machine operator, secretary, stenographer, dictaphone operator, file clerk, utility and service man, airport attendant, mechanic's helper, apprentice mechanic, fabrication and sheet-metal worker, engineer, draftsman, navigator.

The following businesses are already maintaining airplanes and commercial pilots: air transport, oil companies, newspapers, mining, ranching, real estate, geologists, forestry (locating fires, carrying in supplies to fire-fighters, directing fight from the air), charter flights, sight-seeing, student instruction, aerial photographers, aerial advertising, and sowing seed and spraying fields and vineyards in pest control. But air cargo will in large part be new cargo, and students should realize that we have no measurements for its potentialities in terms of present surface traffic.

As global transport is developed, the people employed in air transportation will meet people from all over the world. To work satisfactorily with them, it is going to be necessary to know their languages, their customs, their standards of living. The air transport service of a nation has a task in public relations. The airlines personnel and their passengers and cargo will be representative of that nation wherever they fly. Each person employed in air transport is a part of an experiment in world co-operation. If the school has given him broad social, economic, and political understandings of his international neighbors, air transport may prove to be a strong welding force in the development of a peaceful world community.

Air-age education may serve as a useful tool in integrating the secondary program, and care should be used to insure a continuous program. High-school faculties should co-ordinate their work, and each teacher should have enough practical experience in aviation to make his contributions to his own subject-matter appeal to his students. Every teacher will have some students who know a great deal about aviation. The clear responsibility of the teacher is to utilize these interests and understandings to make the subject matter meaningful to the student in terms of his air-age future.

The following suggestions indicate new concepts and new applications offered by aviation and in some cases reveal a need for a re-direction of aims.

*Social Studies*

Teachers of social studies may show how air travel may lead toward world unity and resulting peace, and how the airplane places nations in new relationships to each other. It seems clear that there is a need as never before for understanding and co-operation among mankind lest the airplane become primarily an element of destruction rather than one of social progress. The following topics are some which need to be considered:

1. Development of air transportation
2. Changed concepts of time and distance
3. Problems of air bases and airways
4. International rules of the air
5. The place of aviation as an industry
6. Contributions of air transportation to our culture
7. Effects of the airplane on other industries—possible decentralization
8. Development of suburban areas in the age of flight
9. Problems of Federal, state, and local regulation of flight
10. The effects of air commerce on your local community
11. Problems of health created by the airplane
12. Dependency of air power on industrial power, access to raw materials, men, and bases
13. The role of air power in future military operations—jet propulsion, rocket bombs, super-bombers, and the like.

In presenting geographical aspects of the social studies, teachers should realize that the airplane has introduced new concepts and aims into their courses. Students should be led to understand the concept of great-circle distances measured in flying hours in a medium that knows no rivers, mountains, deserts, oceans; to realize that no longer is there an eastern or western hemisphere or an eastern or western civilization and that Russians, Chinese, and Indians are our near neighbors; to comprehend the significance of the fact that no point on the earth is more than sixty flying hours away from us, and that the airplane has reduced distance, can make us a world community, and has also made all of us more liable to assault.

It is recommended by the Committee that a social studies course, emphasizing geography with aviation as a strong motivating interest, should be presented in the ninth or tenth grade. Where scheduling does not permit a geography course, social studies is recognized as the proper course in which to present many of the air-age concepts of geography. These concepts, as they may be woven into history, civics, and geography as the fundamentals of social studies, should give the student a well-balanced and world-minded approach. The following topics and activities are some which need to be considered:

1. Construction of a map showing international air routes
2. The disappearance of oceans, rivers, and mountains as barriers

3. The use of time-zone maps to compute time at different places in the world for comparison with your own community
4. Development of a list of geographical areas that have come into prominence because of air transport, with discussion of resultant changes in living conditions in those areas
5. List recent developments that indicate how the world has become smaller in terms of travel time
6. Compute in flying hours how close the United States is to other nations
7. Locate on a globe, air bases necessary for international trade
8. Discuss the value of such bases as Alaska and Iceland
9. What discoveries in world geography have been made through the use of aerial photography
10. Draw on a map the trade routes of the fifteenth century, and then superimpose the air routes of the twentieth century
11. Discuss the probable effects of the air age on the great centers of the world which were built according to the requirements of sea commerce or rail lines.

*English*

Teachers of English find that aviation provides good material for oral and written expression, well-written prose and poetry for reading, and supplies interest in vocabulary study and remedial work. The following topics and activities are some which need to be considered:

1. Talk by a class member on an air trip which he has taken
2. Discussion on air transportation and how different businesses are using this new mode of transport
3. Report given on a subject of special aviation interest, such as the Mars, the Constellation, or the DC-4
4. Collect for the class or the school library articles about historic flights, the development of air transportation, and biographical material that will be of permanent value to the school
5. Reports given on vocational opportunities in aviation
6. Letters applying for positions in aviation
7. Vocabulary study of common aviation terms
8. Discuss need for a common language
9. Have a report given on basic English, its advantages and disadvantages as an international language
10. Reading lists should be provided, which include the many new aviation books — fiction, non-fiction, and poetry.

*Languages*

Teachers of languages may point out to the students that the development of the airplane will increase world travel by Americans, that men and women employed in air transportation here and abroad will be meeting people from

other countries. To have successful business and social relations, it will be desirable to speak more than one language fluently. Students should realize that Americans have not been so language conscious as Europeans, and that air travel and world co-operation demand that we become more proficient in mastery of other languages. The following topics and activities are some which may be considered:

1. Typical travel conversations—buying tickets, making reservations, shopping, eating
2. Monetary exchange—kinds of currency, their equivalents in U. S. currency, conversations concerning purchasing
3. The cultures and philosophies of the people as indicated in their literature.

*Fine Arts*

Teachers of fine arts may encourage an appreciation of the contribution of the air age to materials, color, and design. Students may learn about the development of lightweight materials for air transportation and the airplane, may study the structural design of the airplane, and the inevitable exchange of ideas in crafts as the airways reach the far places of the world. The following topics and activities are some which may be considered:

1. Arrange exhibits of art from different countries
2. Have the students make a museum collection of aircraft materials and pictures showing the development of aircraft
3. Have the students paint murals showing the development of transportation
4. Have the students paint murals showing the development of air transportation
5. Make a study of new materials that have been developed for the airplane and for use in air travel
6. Study the influence of airplane design
7. Have the students make a model of the nearby airport
8. Study airport planning and have the students make drawings.

*Industrial Arts*

Teachers of industrial arts may encourage the building of model airplanes as a means of studying principles of flight and the building of a glider to give experience with full-sized equipment, arrange facilities for building gas-models and radio-controlled models where interest is shown, and teach certain phases of engine mechanics. The following topics and activities are some which may be considered:

1. Model airplane building may be a club activity from the seventh grade through the ninth. Airplane parts should be made from raw materials whenever possible
2. A scale-model glider or a full-sized glider may be built in junior or senior high school as a class activity

3. The building of a gas-model offers the opportunity to study the internal combustion engine
4. The study of the internal combustion engine—operation, performance, maintenance with emphasis on practice instead of theory, may be organized in conjunction with the high-school aeronautics course in the automotive department or the shop department
5. The building of a radio-controlled model may be offered, not as a class project, but to interested eleventh or twelfth grade students and to exceptional students in lower grades
6. Laboratory-type work may be offered through co-operative arrangements between shop and aeronautics teachers
7. Flight experience is recommended in senior industrial arts courses
8. Study of aircraft construction materials; strengths and weights of metals and alloys and structural design.

*Mathematics*

Teachers of mathematics will find in aviation excellent problem material which will stimulate the interest of the students in mathematics and in aviation. Wherever possible authentic data should be used so that students will acquire accurate knowledge about the airplane and air transportation, for example: fuel consumption, transportation costs, percentage pay load. The following topics are some which offer problem material:

1. Costs and time of passenger and freight transportation by the airplane and by different kinds of surface transportation
2. Use of the metric system and English system of measurements in computing distances, wing areas, landing strip areas, volumes of storage space
3. Monetary systems of the different countries of the world
4. Conversion of American gallons to British gallons, statute miles to nautical miles
5. Construction and interpretation of graphs on the growth of air transportation, costs
6. Formula work on shear, compressive, and tensile strengths, per cent pay load, wing loading, wing area, aspect ratios, landing velocity, tip speed, lift, drag, horsepower, gliding distance, angle of glide, angle of bank, fuel consumption, piston displacement, power loading
7. Air navigation; problems in dead reckoning
8. The use of the slide rule and logarithms will be appreciated by those taking the course in advanced science of aeronautics.

*Biology*

Teachers of biology may emphasize study of the physiological effects of flight. The following topics and activities are some which may be considered:

1. The gliding, soaring, sailing, and normal flight of insects and birds
2. Make a study of respiration

3. The effects on the human body of changes in altitude, oxygen, temperature, and acceleration
4. The effects of sense organs on balance and co-ordination
5. The requirements of physical fitness for flight: nervous system, hearing, vision, balance, blood circulation. The high standards of health requirements for pilots may stimulate better hygienic habits of the students
6. Learn what is being done to prevent the spread of pests and diseases through air travel
7. Study methods of spraying crops, mosquito control, and learn how the airplane is used in work of this type
8. Air sickness and how it may be minimized or overcome.

*Physics*

Teachers of physics may present many applications of fundamental physics principles to the airplane and flight. Students should realize these applications exist and be encouraged to understand thoroughly the principles involved in order to make further applications in real situations outside of school.

The following topics are some which need to be considered:

1. The airfoil and Bernoulli's theorem
2. Kinds of energy—potential, kinetic, chemical, heat, electrical, and mechanical; and where they are found in the airplane
3. Mechanics—center of gravity, moments, glide angle, trajectory
4. Heat—carburetion, combustion, compression, cooling system
5. Why an airplane flies
6. Ignition system
7. Radio and its uses in air navigation
8. Convection, humidity, clouds, fog, frost, icing.

*General Science*

Teachers of ninth-grade general science may present aviation-centered units. The extent to which some of these may be developed will depend on the abilities and previous experiences of the pupils. The following questions and topics are some which need to be considered:

1. How are airplanes constructed?
2. Why does the airplane fly?
3. What are the different types of airports, their uses and limitations?
4. What is the necessary equipment for an airport?
5. What are the Civil Air Regulations concerning airport traffic?
6. What is a flight plan?
7. What part does radio play in flight?
8. Study of lighter than air and heavier than air types of aircraft
9. How does a parachute work?
10. How do changes in air pressure affect the aviator?
11. What causes changes in air pressure?
12. What is atmosphere?

13. How are weather forecasts made? How are they used by aviators?
14. Model airplane building in co-operation with the shop department.

The consumer science or modern science course in the twelfth grade should have a strong unit in aviation. The extent to which aviation topics will be developed in this course will be determined by the abilities and experiences of the students. The following topics are some which need to be considered:

1. Composition and structure of the ocean of air
2. Weather, particularly North American weather, weather forecasting, and weather maps
3. Principles of flight
4. Different types of airplanes and their uses
5. Purposes of different types of airports
6. Private and commercial flying opportunities
7. Safety education, present and future traffic control.

It is assumed that the teacher will indicate vocational possibilities in connection with these topics and will discuss their social, political, and economic implications with the students.

*The Library*

The library in the public school may perform a service in aviation education for both students and adults of the community. Books of aviation interest, both technical and non-technical, poetry and prose, fiction and non-fiction, should be procured. The school library should subscribe to several good aviation magazines. It should encourage the students to contribute aviation clippings to be posted on the library bulletin board and articles which may be displayed on a special shelf or table and later filed.

Charts, maps, and booklets on different phases of the aviation industry, private flying, and air commerce, and pamphlets on occupational information about aviation may be prominently displayed in the library. Weekly aviation exhibits may be arranged. One display may show the different types of maps and globes with instructive material concerning their uses, advantages, and disadvantages. These will stimulate interest in aviation by the students. Another exhibit may feature vocational information concerning jobs in aviation as a part of a general vocational guidance program. Students may visit the library in small groups to hear vocational talks by a faculty member several weeks before they make their choices of courses for the following year. The students' schedules can be arranged to allow ample time to read and study the vocational material. Loans of books or other materials may be arranged with the public library and through the State Department of Education.

Other exhibits may feature stories of aviation history and its heroes. Students of all grades can visit the library in groups to hear students talk about their favorite aviation pioneers and ace flyers and the books about those people.

Such use of the school library helps both library and student. The library finds in aviation a stimulating interest to attract those students who heretofore

may not have read eagerly. The library, alert to the needs of its students, may be a strong force in making general aviation education available to the school. Co-operative programs between the library and the teachers of English, social studies, science, and others will permit the fullest use of available resources.

The local public library should be urged to offer aviation materials for young and old. A display of books and articles on phases of air transportation, military air power, city planning, airport planning, and problems of decentralization will encourage interest by the community. The public library may aid the schools by making loans of suitable materials.

Where the public library cannot function so actively, the high-school library may encourage community interest by making book loans to the adult public. Aviation education in the schools should be accompanied by interested support of the community if the program is to be successful.

### THE SCIENCE OF AERONAUTICS COURSE

The course in the science of aeronautics does not in any sense take the place of the program of incorporating appropriate materials on aviation and its social implications in all other high-school courses. The science course is therefore intended to be in addition to the program described in the preceding part of this report. Indeed, the science course is subject to the incorporation of relevant materials which are not an outlined part of the course itself. The subject matter is science, but an understanding of the political, social, and economic implications of this science are among its more important outcomes. These should be taught in connection with the principles of aeronautics science whenever they may add to the effectiveness of the total teaching result. The aeronautics teachers should also supply information about vocational opportunities in aviation as a regular part of the instruction and, in the cases of individual students, upon demonstration of interest or inquiry by the student.

The science of aeronautics course is no longer a pre-flight course. It has outgrown that stage in its development. It is to be regarded as general education in modern science, and it should be open to both boys and girls on an elective basis in either the eleventh or twelfth grade. It should result in a general background for aviation vocations; it should provide the basis for successful private, commercial, or military flying; it should provide a richer understanding of the influence and the potentialities of the airplane for all students, regardless of their future personal participations in aviation. Its very flexibility of content and purpose permits a school to draw fully on its resources, to make adaptations for the particular class, and to make further important adaptations to the needs of individual students. The objectives of the course in the science of aeronautics are at least as broad as the objectives of any other science course taught in high schools.

There are probably no two aeronautics courses alike in the state of Connecticut. The abilities of the teaching staff and other distinctive features of the local situation have properly influenced the content of the course and the

administrative arrangements necessary in offering it. The suggestions of this report are general; it is expected that local adaptations will be desirable and will be made.

*Teachers*

Preferably, the teacher of aeronautics should have a background of science and mathematics, some study in the field of aeronautics, an interest in aviation, flight experience as a flyer or as a passenger, and experience in aviation activities, such as air navigator, pilot, and meteorologist. Other qualifications assumed to be equal, the more of these experiences a teacher has, the better he should be teaching the science of aeronautics.

*Students*

The abilities of the students will also affect the character of the course in the science of aeronautics. Student ability is determined by student selection. Most schools offer this course in the eleventh and twelfth grades, where studies reveal it is most successful. This practice is recommended.

At the present time in Connecticut, many of the seventy-nine schools teaching aeronautics are giving the course to a selected group who have a background of mathematics and physics or are concurrently studying physics. For such highly selected students the courses have not been too difficult, but they have been taught on a level of academic difficulty far beyond the abilities of a majority of high-school boys and girls.

There is another group of students in Connecticut, much larger and more typical, who need not only education in modern science, but an understanding of the changes the airplane has produced and will produce. They need a background for citizenship as well as for many vocations and avocations, of which piloting an airplane is only one. It is desirable that aviation instruction be made available to this large group of students, either in a science of aeronautics course or in a consumer science course, or in a social aviation course.

A few schools have required an interest in aviation as the only prerequisite for the science of aeronautics course. These courses have recruited a large number of students who have a much wider range of ability. Whatever doubts may have existed when the course was regarded as primarily for preinduction purposes, the results have been found to be satisfactory. Realizing the need for knowledge of certain principles of physics or further techniques in mathematics, these less rigorously selected students have responded well to instruction. The Committee recommends that the prerequisites for one of the courses in the science of aeronautics be made so that at least seventy-five per cent or eighty per cent of all boys and girls may elect to take it if they should choose to do so.

Occasionally a school may offer a two-year course in aeronautics. This may consist of a general introductory course open to all for one semester, touching all topics, but without solution of formulas, and the like. Then for those who

are prepared for more advanced study, three semesters may be devoted to a more thorough presentation of such units as aerodynamics, radio, navigation, meteorology. The Committee believes that to lay down one aeronautics program for all is unnecessary and unwise, and it would rather encourage a variety of patterns in local schools according to the facilities of each school.

The Committee recommends, however, that whenever possible two levels of aeronautics courses be offered—one, a general course with no prerequisite other than interest; the other, a course of a more technical nature for those having a mathematics and science background. Each course may be given two times a year or a half year in length or the advanced study may be divided into half-year specialized units in meteorology, air navigation, and others. The latter units may be distributed among certain teachers; for instance, navigation may be taught by a mathematics teacher. When only one course in aeronautics can be offered, it should be a full year in length and should be organized so that at least seventy-five per cent of the juniors and seniors in high school will be able to succeed should they elect to study it.

In addition to an elective course in science of aeronautics, it is recommended that where a ninth-grade general science course or a twelfth-grade consumer science course is given, that these be considered as opportunities for strong aviation-centered units. Groups of teachers on different levels should experiment and develop special aviation units to present these and other science courses as well as courses in other fields.

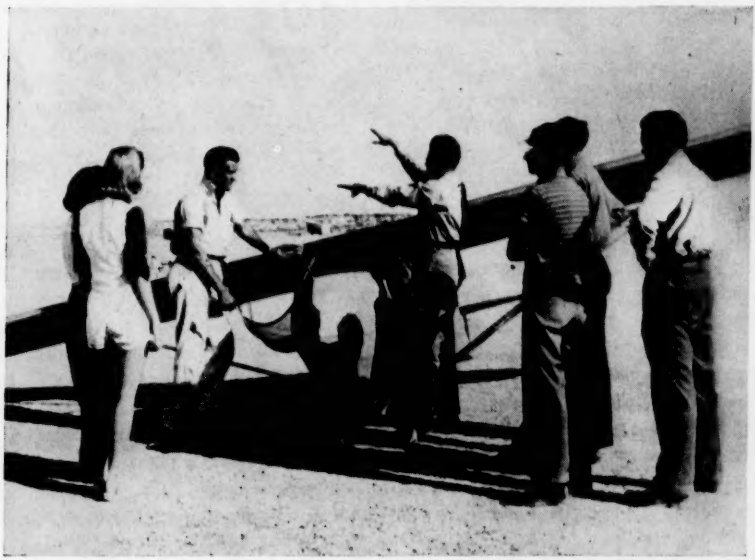
As this report is written, the Civil Air Patrol is offering instruction in International Code, military drill, and some two-hundred hours of aeronautical instruction in several locations in Connecticut. These pre-induction studies supplement the school experience for boys and girls over sixteen years of age in the Junior Reserve Program of the Civil Air Patrol. It is urged that the CAP and the schools co-operate on the local level so there will be no duplication of instruction and in order that all the efforts of both the CAP and the schools will further aviation education in Connecticut.

The Committee presents the following program as a tentative schedule, flexible in range, for a science of aeronautics course. It is planned for 160 class periods from forty to sixty minutes in length in addition to some flight and laboratory experience, but it may easily be adapted to school terms of varying lengths.

| | |
|---|---|
| Implications of the airplane for society | 5 periods |
| Aircraft structures | 10 periods |
| Aerodynamics | 30 periods |
| Civil Air Regulations | 15 periods |
| Power plant | 20 periods |
| Meteorology | 40 periods |
| Air navigation | 30 periods |
| Testing | 10 periods |
| | 160 periods |

The teaching of Civil Air Regulations as a part of the course in aeronautics is considered sound. True, these regulations change in detail occasionally, but the principles for regulations of air traffic and the reasons for regulating it remain essentially the same. It is important that the public understand the general pattern of air traffic and regulations, and be directed toward safety in aviation.

The use of airplanes has increased rapidly in our society. They will be with us from now on, for good or ill. They make many problems more serious and far more urgent than they ever have been. How wisely we solve these problems will determine whether the airplane becomes an element of destruction or a force for peaceful progress. Unless we direct the use of the airplane toward peaceful participation in a world community, all nations will be in danger of attack from the air. Unless we recognize the need for good safety education in the use of the airplane, it may be an element of destruction even in a world at peace. One has only to read the list of suspensions of flight operators' licenses and their causes to realize how serious this problem may become. We must use all the educational facilities we have to direct the advanced technology as demonstrated by the airplane into the main currents of our culture. It can enrich and preserve that culture or it can destroy or weaken it.



**Here high-school boys and girls, interested in this expanding field, learn some of the fundamental principles of air buoyancy as they apply to the operation of a glider.**

Flying is on its way for the younger generation, and the school has the opportunity to do worth-while civic service. Training planes will soon be easily available. Licensed flight schools, properly inspected and certified by the Civil Aeronautics Administration, employing properly certificated flight instructors, insure good instruction. But other schools and other instructors less reliable in character will mushroom. They will want to take our young people into the air. On their part, the young people want to fly, to learn all they can about aeronautics. They should be able to do so under the most desirable sponsorship and in the safest and most effective manner possible. The proper agency to assure these things is the school. The school should encourage safe and sane flight for young people in school, and it may properly perform the same services for youths who are not in regular attendance at school, that is, those who have completed school or left before completion.

Wherever it can be organized as a part of the school program, four hours of flight experience is recommended for each boy and girl taking the sciences of aeronautics courses. Such experience is highly desirable to demonstrate the operation of principles of aerodynamics, meteorology, navigation, Civil Air Regulations, power plants, and other important units in the science of aeronautics course. Personal flight experience aids one's understanding of the airplane in flight, and stimulates interest and appreciation of flight. This flight experience is not recommended as military pre-induction for training of pilots, or to help students in making aviation their vocational choice, although it may in individual cases supply an excellent background for any of these. It is to be regarded as a laboratory experience, a part of general education in science comparable to four hours spent in the laboratory in connection with a traditional course that is offered in nearly every secondary school in physics.

### FLIGHT EXPERIENCE AS LABORATORY WORK[1]

### PILOT TRAINING

Pilot training for private flying may be taught in a manner which will serve the purposes of general education, as well as meet the objectives in connection with vocational training in aeronautics. Pilot training should follow approved patterns already developed by the Civil Aeronautics Administration for primary flying schools, and should not be terminated, except in cases of student failure, short of the thirty-five to fifty-hour program essential for competence. If a choice must be made between the laboratory-experience program and the pilot-training program the Committee recommends flight experience rather than pilot training on the principle of service to the greatest number, so far as science of aeronautics students and those in aviation-centered courses are concerned.

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[1] For the outline of flight experience as laboratory work, the reader is referred to the Illinois program found on pages 30-36 of this publication.

SUGGESTIONS FOR LABORATORY EXERCISES IN SCIENCE OF AERONAUTICS COURSES

The following suggestions concerning laboratory exercises of traditional types are illustrative rather than exhaustive; they refer only to limited portions of three topics of the aeronautics course.

*Aerodynamics*

1. A series of experiments may utilize the physics laboratory to illustrate certain scientific principles, such as Newton's Laws of Motion, Pascal's Law, Charles' Law, and Bernoulli's Principle.
   a. Common atomizer
   b. Venturi Tube (gas or water run through a tube with a constriction in it will suffice.)

2. To demonstrate streamlining, use a stand with an upright rod on which a flat plate, sphere, or model wing section may be placed in a wind and smoke stream.

3. Balanced moments may be illustrated by using an airplane cut from plywood and painted to represent a two-dimensional reproduction. The center of gravity is found, and a bolt is placed through this point to an upright stand, so the airplane may be free to swing. The center of pressure is marked. Small hook-eyes are placed at points which represent the perpendicular distance through which the four forces (thrust, drag, weight, lift) act. Strings are attached to these, and by exerting a force on any one, the behavior of the airplane can be studied. Combinations of forces are also considered, and finally the equation for "Balanced Forces in Flight" is derived.

4. A wind tunnel may be used to demonstrate principals of aerodynamics. Each student may construct an airfoil of his own choice for experimental purposes. It is recommended that National Advisory Committee Reports Nos. 315, 573, and 628 be used.

Each foil is placed in the wind tunnel by the owner, and a series of "tests" for varying angles of attack are run. The number of grams of lift and drag are recorded in a table. After these figures have been converted to pounds, they are fitted to the formulas for lift and drag, and the coefficients of lift and drag are computed. These are graphed in the typical manner. The results of the individual tests are compared and studied for correlation to the actual curves derived by the National Advisory Committee for Aeronautics.

A pressure-measuring test section is placed in the tunnel. This is merely a large Clark-Y foil arranged so that by turning a crank on the outside of the tunnel, the angle of attack may be controlled. The foil contains openings in the upper or lower cambers, and copper tubes are attached to these at right angles. These tubes are connected to small rubber tubes and a series of glass tubes immersed in a colored fluid. Hence, when the angle of attack is varied, the rise and fall in the tubes is observed and recorded. The movement of the center of pressure is thus established.

Artificial smoke is generated by using ammonium hydroxide and hydrochloric acid. This is sent under slight pressure into the tunnel. The behavior of the air stream over the foil is observed. The angle of attack is varied, showing the movement of the center of pressure. This is excellent to illustrate burbles and turbulence.

Small scale-models are made of the type used by the air corps for identification study. One is made with left aileron, up; right one, down. Another is made with the ailerons in opposite positions. These models are then placed on a small stand so as to be pivoted from nose to tail, free to move on the longitudinal axis. When the air stream is sent through, the "rolling" phenomena is studied. Banks of all degrees can be studied by merely controlling the speed of the air flow in the test section.

Likewise, models are made with the rudder turned left and right. These models are placed so as to have movement about the normal (directional) axis. Thus, yawing is studied.

Finally, models with elevators in varied positions are made, and fixed to move about the lateral axis so that pitch can be observed.

The effectiveness of a flap may be shown for varying degrees of angle of attack by attaching it to an airfoil. Likewise, models with simple slots are made. "Smoothing" out of airflow is observed when smoke stream passes over.

5. Study of stresses: tension, compression, bending-shearing, and torsion can also utilize physics laboratory equipment.

*Meteorology*

Day-night phenomena may be illustrated by the use of a globe, and a central source of light whose rays are made to strike the revolving globe.

Prevailing Westerlies may be studied by spinning a slate globe, and then bring a piece of chalk to bear on the surface from north to south. To illustrate differences between stable, neutral, and unstable equilibrium, use a large bottle and a smaller one which will slip into the larger one. Fill the large bottle with water. Fill the small one with water and quickly slip it, open and down, into the larger one, so that it rests bottom end up on the surface of the water. Now insert a cork in the large bottle. By putting pressure on the cork, the small bottle (diver) can be brought up or down.

A "cloud" may be made in a beaker by applying heat from a Bunsen burner.

Fog may be formed by blowing across ice cubes in a shallow pan.

Use physics laboratory equipment to demonstrate static electricity. An amateur weather station may be located on top of the school building. Barometer and thermometer readings may be made here at intervals of two hours. Wet- and dry-bulb readings may be taken, and relative humidity may be computed. Wind direction may be determined by a wind sock. Computation of the dew point may be made from a silver loving cup. Observation and classification of sky-cover, estimates of visibility, computations of "ceilings", and rough forecasts of weather may be made.

*Air Navigation*

A Mercator Projection map can be made by using the northern hemisphere of an old globe and a cardboard cylinder which is tangent to the globe at the equator. The outlines of land areas are perforated with a sharp instrument. A light is put into the hemisphere. The points indicating the outlines of the contingent are thus "projected" on the cylinder. Similarly, a Lambert Conformal Projection may be illustrated by placing a cardboard cone on the perforated hemisphere. The Polar Gnomonic Projection can be illustrated by placing a rectangular flat sheet of cardboard tangent to the North Pole. Using a piece of string, measure distances between two points on the globe. Point out the interesting facts, such as that Venice, Italy, is actually farther north than Vladivostok, Siberia.

These experiments obviously do not cover all portions of the course in the science of aeronautics. Neither are they intended to be exhaustive in the few fields from which the illustrations have been taken. They are intended, rather, to indicate types of laboratory experiments which require little or no extra equipment for established science laboratories in high school.

### AIR-AGE EDUCATION IN THE VOCATIONAL SCHOOLS

The vocational program in Connecticut includes training programs for four groups in the aviation industry: service mechanics, airframe mechanics, production workers for aircraft engines and accessories, and manufacturing technicians and inspectors.

There are twelve state vocational schools, located at Bridgeport, Danbury, Hartford, Manchester, Meriden, Middletown, New Britain, Norwich, Putnam, Stamford, Torrington, Willimantic, and a state aided, locally operated vocational school at New Haven. *The Putnam State Vocational School* specializes in aircraft-mechanic and aircraft engine-mechanic trades. *The Bullard-Havens Technical School* at Bridgeport offers training in airframe manufacture. *The Hartford State Vocational School* gives training in aircraft engine assembly. Although the other vocational schools do not offer specific instruction in the aviation trades, all offer courses in machine shopwork which is one of the essential trades required in the manufacture of aircraft engines and therefore all the schools can be said to contribute to this industry.

The training at the *Putnam State Vocational School* includes all major phases of technical and operative work encountered in the aircraft-mechanics and aircraft engine-mechanics trades. Effort is made to stimulate conditions in the aircraft industry as closely as possible. All work is done in accordance with Civil Air Regulations governing construction, alterations, and repair of the licensed aircraft. Instruction is given in the use of mathematics and science as related to these trades, in reading blueprints, and making suitable working sketches. The student must learn sufficient general and trade English to enable him to understand written directions and technical specifications common to these trades, and to express his ideas clearly. Instruction in the current require-

ments of the Civil Air Regulations for the Aircraft-Mechanic and Aircraft Engine-Mechanic ratings of the Civil Aeronautics Administration is given wherever these relate to the duties and responsibilities of an aircraft or engine mechanic. The course emphasizes the values of organization, co-operation, safe work methods, accuracy, extreme care, thoroughness, dependability, punctuality, and cleanliness so essential to public safety and individual success in the aircraft and engine-mechanic trades.

The training period for the combined course in Aircraft Mechanics and Aircraft Engine Mechanics is not less than 4,800 hours of satisfactory work. Separately, each course is not less than 2,800 hours of satisfactory work, or 5,000 hours for both courses if taken consecutively. This allows 2000 hours for review work necessary where the training does not run concurrently.

Approximately sixty per cent of the total instruction time is operative and forty per cent is related to technical instruction. These courses are also useful as auxiliary training for aviation occupations for which the CAA mechanics ratings are not required, such as that of commercial pilot.

A period of machine-shop practice, probationary in character, is required before entrance to any type of aircraft mechanics instruction to determine whether the student will be a safe mechanic.

Maintenance mechanics are trained for equipment maintenance, overhaul, repair of the airplane, its engine, and radio and electrical equipment. Civil Air Regulations require a check-up of the aircraft at the end of a given number of flying hours. The number will vary with the type of plane and its use. This work has to be done by licensed aircraft mechanics and aircraft engine mechanics.

There should not be too much specialization in maintenance. Maintenance is not a job of the assembly line. The mechanic at the airport servicing planes will be on his own, meeting many types of problems. He must have a thorough training and a real understanding of the theory and use of a part in order to make the necessary decisions and do the work correctly. He is his own inspector, and it is over his signature whether the airplane is airworthy. The service mechanic must be a highly dependable man, for the success of air transport depends on his work.

An orientation unit in each course will be a valuable aid to the service mechanic or the worker in the plant. If he knows the function of the part he is making, he takes more interest in his work, and the quality improves. This knowledge is necessary to the industrial worker in any field.

The man of the mechanical type of mind and interests realizes the limitations of the airplane and the human being, and is correspondingly conscious of the need for safe workmanship. Whenever possible the student should be given real experience in order to make him a good craftsman. In the *Putnam State Vocational School* damaged airplanes are brought into the shop and completely rebuilt, and are Federal and state inspected as the rebuilding

progresses. This offers an excellent learning situation. Mathematics, drawing, and related subjects should be tied into a real learning situation wherever possible. The student must thoroughly understand the "why" as well as the physical skills because someday he will have to meet real problems alone. For him, theory and practice must become one.

It is necessary that the general mechanics training be a series of experiences under highly trained men. The instructors must be tradesmen, qualified mechanics in the field. They must have successful teaching techniques, keep in step with industry, and know how to organize the content of their courses. It takes up-to-the-minute concepts and methods to make the necessary applications. It is important that instructors have flight experience so that they feel a deep responsibility toward inculcating in their students the need for excellent workmanship.

The Connecticut Committee on Aviation recommends ten hours of flight experience each year for students who are aircraft or aircraft engine mechanics. Students at the *Putnam State Vocational School,* regularly enrolled in the Aircraft Mechanics Course may with the permission of the Director and their parents or guardians accompany a licensed pilot in making test flights of planes owned by the state and overhauled by the students of the Aircraft Mechanics Course. Flight in an airplane one has helped rebuild gives a real appreciation of needs. A man must have an aptitude for such work. He must be a man of high integrity, and his work of the finest quality in order to be considered a safe mechanic, one on whom the public may rely. He must have a knowledge of the theory of flight and an understanding of stresses and strains to realize fully the responsibilities that are his. Safe maintenance is essential to safe flight.

*The Bullard-Havens Technical School* at Bridgeport offers training in airframe production. At present, much of the work is offered in connection with the War Production Training Program. There are courses in aircraft sheet-metal work and riveting. Students are trained to be skilled operators and some are trained as mechanics in design and experimental sheet-metal work.

*The Hartford State Vocational School* offers instruction in aircraft engine assembly in an evening course, which is given two nights a week, three hours a night. This course provides approximately 100 hours of supplementary training for those already employed as assemblers of aircraft engines. The purpose of training a group already employed is to extend their skill and knowledge and the work is done to meet the specifications of the employer. This course is also a splendid medium for an orientation program. Workers in other lines in the same company are encouraged to go through an aircraft assembly course for purposes of appreciation. In the future such courses may be developed for both public and company employees. Another course gives 150 hours of pre-induction training in aircraft engine assembly. It includes

information for the carburetor specialist, propeller man, and ignition man as he works in the factory and the operational field. A pre-induction course in the science of aeronautics is also offered two nights a week.

Two technical-industrial courses are offered in Connecticut vocational schools to equip graduates with technical knowledge and practice for such positions as industrial inspectors, foremen and supervisors, assistant department heads, department heads, superintendents, and assistants to engineers. These positions are on the junior-executive or junior-engineer level and require considerable responsibility and intelligent planning and judgment.

One is a four-year course for those who have completed grammar school or its equivalent, and the other, a two-year course for those who have completed high school or its equivalent. These courses include a wide variety of shop experiences and technical training.

The shop work in these courses acquaints the students with the work which may be done in each shop. The student in the technical-industrial course will have about 600 hours of machine shop whereas the regular machine-shop trade-training course offers 3,200 hours. There are 200 hours of foundry experience in the technical-industrial course, but 3,000 hours are offered in the regular foundry trade-training course.

The training of manufacturing technicians, inspectors, machine operators, and similar technical personnel should prepare students for any metal manufacturing field, including aircraft. It is the belief of the Committee that there is not a great deal of difference between training for occupations in aircraft engine manufacture and other industries manufacturing metal products.

It is planned to offer a program training the workers for those occupations where technical knowledge predominates rather than skill, such as occupations in production industries, airport maintenance, and operational work. As plans are not yet completed for an airport network in Connecticut, no data is as yet available on the local demand for such training.

Flight experience in connection with these vocational programs is recommended by the Committee as desirable laboratory experience. This should be approximately ten hours for each student.

The Committee believes the state should take over and develop an airport and build a suitable hangar and buildings to house a training program that would permit of completeness in each phase covering engines, planes, propellers, accessories, instruments, and radio, together with necessary related theory and technical instruction. The Committee recommends that each phase of the training program be adequately equipped and under the immediate instructional guidance of an expert in that particular branch so that each trainee may progress properly from section to section. Complete fundamental training should be acquired during the first year-and-a-half of the course. During the latter part of the training, student experiences would be based upon bringing together all previous training and actually applying them in

the form of full servicing and maintenance of licensed aircraft. This program could be located in the country and supervised dormitories provided for students in training. These facilities should be designed to care for an eventual enrollment of 250 to 300 students.

The postwar program of the vocational schools will include trade training, technical, pre-employment, supplementary, and part-time extension courses. It is the belief of the Committee that the vocational training problem for the next few years does not justify too much expansion for maintenance, operation, or production training, but that some of all three, nevertheless, are needed.

For awhile returned servicemen will supply many aviation jobs on the service and skilled mechanic level. As they qualify as safe workers, they will get jobs. They may need supplementary education, and if so, should be given it. The training program of the vocational schools must be a flexible program to meet the needs of returned servicemen and the younger student group. The training must be complete and thorough. The sound growth of aviation will depend on a well-trained personnel. To give the best preparation, vocational schools must be informed as soon as possible of all the changes that have been made during the war years. And thereafter the schools must be kept modernized. Vocational schools doing a good job will have a future. If they provide a functioning program, they will command the respect of the people using them, and the public will support them.

### AIR-AGE EDUCATION IN COLLEGES AND UNIVERSITIES

The junior colleges, colleges, and univeristies have special obligations in aviation education to aeronautical engineering students, to students interested in semi-technical, sales, or service jobs in aviation, to those desiring pre-service or in-service instruction for teachers, and to the adult community. Aviation education should not be restricted to these groups, however, but should be presented in some form to all students, particularly in relation to the social, political, and economic effects of aviation as these concern the individual, the state, the nation, and the society of nations. Therefore, there should be an incorporation of air-age materials in the non-aviation courses in the colleges and universities. An indication of the scope of aviation education may be found in the secondary-school section of this report. The college programs should offer more advanced and detailed air-age knowledge than can be obtained on the secondary level. This should result in a thorough modernization of college subjects, especially as it contributes functional materials to them.

It is desirable to make an analysis of the aviation education that the student has received prior to entering the higher institution in order to determine his needs and advise him as to the proper courses to elect. There are courses in geopolitics, various phases of aviation science, economics, and other fields which are appropriate for students who have had some instruction in this field, as well as for those who have not. Articulation of the programs of secondary schools, vocational schools, colleges, and other institutions on the

various levels is highly desirable if the best interests of all students are to be served.

All college and university students will profit from a course in geopolitics or aeropolitics. It should be an elective, but if it is a good course, many students will elect it. Problems in town and airport planning, decentralization of industry, and development of suburban areas are a few of the air-age problems which will face many communities. Therefore, some preparation is needed on the general level.

Teachers colleges, colleges, and universities engaged in the education of teachers have special responsibilities in the aviation education program. Unless excellent preparation be given in pre-service and in-service instruction of teachers, all phases of aviation education will be conducted under serious limitations. There must be incorporation of aviation material in college courses, and special courses in aviation science and social aviation, in order to get information to teachers and prospective teachers in elementary and secondary schools. Workshops should be set up in the colleges or by the State Department of Education to accomplish the necessary curriculum study and integration, to develop aviation education materials, and to make evaluative studies of available teaching aids. Teachers should then be kept informed by the State Department of Education of new teaching aids and textbooks as they are made available, drawing upon the Civil Aeronautics Administration and other public or private sources for its information.

*Elementary Teacher Education*

Elementary teachers need preparation in aviation science and social aviation in order to meet adequately the needs of their students. Air-age materials may be offered in separate courses and should also be incorporated in science and social studies courses in the colleges. It is difficult to talk about the implications of flight unless one has a knowledge and appreciation of flight. For that reason, trips by air should be made available to teachers, and flight instruction or experience will be helpful. The local airport should be used as part of a carefully planned program. Workshops should be set up in order to produce teaching aids for use in air-age education in the elementary schools. Attitudes and content of curriculums need overhauling to insure proper direction and integration of the subject matter which can be adapted by teachers to the needs of children in the elementary schools.

*Secondary Teacher Education*

Institutions for the education of secondary teachers should present pre-service and in-service programs which will aid teachers to present phases of aviation education in their individual subjects. They should offer instruction in general consumer education, emphasizing the social aspects of aviation. A science of aeronautics course is desirable for teachers expecting to teach such traditional sciences as physics, biology, or chemistry. A more advanced science of aeronautics course, or a series of courses in the prinicpal sections of aero-

nautical science, should be made available to teachers of science of aeronautics in high schools.

Secondary teachers will find integration necessary to prevent overlapping of content of courses. Careful evaluation and overhaul of content of courses will be required to insure the inclusion of valuable air-age materials in the secondary school for students who do not study regular courses in aviation. Study of the secondary-school report in this publication will indicate the far-reaching effects of aviation on the educational program in general. Workshops should be set up to insure the incorporation of the materials of aviation education in the secondary curriculums. The airport is a valuable field resource to be used in co-ordination with the classroom program. Flight experience is desirable for all secondary teachers, and the Committee recommends flight instruction up to ten hours for present teachers of aeronautics. It is recommended that the latter be financed by the local board of education. No institutions of higher education in Connecticut have yet announced regular programs of teacher education which meet the requirements of the elementary and secondary schools, although some special aviation courses for teachers have been made available from time to time.

Higher institutions also have a real responsibility to the adult community in regard to both personal use of the airplane and its many implications. It is recommended that as soon as possible courses which will develop a better understanding of the air age be made available for business men, particularly those interested in transportation, and for all adults in the communities where an interest is manifested. Such courses may properly be concerned with the present status and probable future of air transportation, problems of airport and town planning which may face the community, or problems concerned with aviation science or industry. Courses for adults who are interested in aviation only as citizens could be concerned with problems of private ownership, such as the economics of private flying, practical maintenance, and Civil Air Regulations. The public should be led to appreciate the new relationships in which the airplane has placed us in respect to other nations, and how the use of the airplane should be and can be directed toward world unity and peace.

Such courses will contribute to the public's understanding of the aviation education program of the schools, and will encourage community support of such programs as laboratory flight instruction and air safety education. If such courses could be offered in the late afternoon or evening, many citizens would be able to enroll.

It is strongly felt by most schools of engineering and by many officials of the aviation industry that the best preparation for engineering is a thorough knowledge of underlying principles and basic relationship illustrated as completely as possible by contemporary developments. It is believed that specific programs of study primarily concerned with the techniques and skills pertain-

ing to the aviation industries would restrict the student's attention to the particular and temporary characteristics of the present study. The aeronautical engineer needs preparation in mechanical, electrical, chemical, mining, and industrial engineering as well as study in aeronautics, for he is concerned with design, mechanics, aerodynamics, stress analysis, electricity, instruments, radio, metals, aircraft materials, aircraft engines, wood and metal fabrication, welding, construction, repair, and maintenance shop. The aeronautical engineer's course should give him a composite picture of design, manufacture, radio, and operational field work, and the economics and principles of air transportation.

In reply to inquiries, several colleges and universities in Connecticut have outlined their offerings in some detail. *Trinity College* and *Rensselaer Polytechnic Institute* have developed a co-operative program whereby a student completes a three-year pre-engineering course at *Trinity* and a two-year engineering course at *R.P.I.* The student receives a B.S. degree from *Trinity* and an engineering degree from *R.P.I.* This pre-engineering course at *Trinity* is designed as a foundation for any type of engineering course.

The following courses at *Trinity* will be useful to those desiring advanced study in aviation: engineering drawing, descriptive geometry, engineering materials, strength and elasticity of materials, fluid mechanics, mechanism and elementary machine design, and thermodynamics and heat power. Courses are also offered in navigation, nautical astronomy, and astronomy. The course in economic analysis will include material on air transportation and the increased accessibility of markets as a result. The course in geography will be re-designed to include the pertinent air-age material. The International Relations course and Seminar in International Relations or political geography will include air-age material.

While the postwar plans of the *University of Connecticut* are not complete, it is planned to develop a program of educational research which will attempt to meet the needs of an aviation minded postwar world. It is planned to include facilities of the government-owned Willimantic Air Field, and the Bradley Field facilities along with a new aeronautical engineering building at the University.

The general purpose of the University program will be to provide an educational center at both the undergraduate and graduate levels where students may study in any or all fields of knowledge related to air transportation. The demands of postwar aviation education and research range from astronomy and physiology to sociology and zoology; from medicine to engineering; from agriculture to commerce; from law to business management; and include nearly all sciences.

Among aviation research projects are: (1) studies of site selection as affected by grading, drainage, obstacle hazards, and future expansion possibilities; (2) studies to determine the most practicable turfing for small land-

ing strips and small airports; (3) studies relating to the most effective methods for handling and trans-shipping cargo with minimum damage and loss of time; (4) air transportation of foods and perishable cargoes, including vine-ripened or tree-ripened fruits, quick-frozen foods, and other kinds of cargoes; (5) problems of parking arrangements for passenger and cargo handling; (6) problems of general business and management operations involved in aviation; (7) aviation medicine, including studies of the effects of oxygen deficiency, pressure changes, and temperature changes in air transportation upon passengers not in perfect health; (8) state and Federal laws affecting air transportation. Programs will be developed to train ROTC air-force units including pilots, technicians, and mechanics.

At *Yale University,* School of Engineering, the work has been organized around the central objective of a broad scientific and technical educational foundation that would permit young men to enter the engineering field well grounded in principles and the disciplines of mathematics and both pure and applied science, that would enable them to acquire promptly and effectively the specific techniques and skills required in the particular field upon which they might enter.

In the natural development of lecture programs, seminar discussions, and the presentation of the regular engineering courses, there is inevitable reference to applications of scientific developments and the principles and practice of engineering to aviation and the new structures, equipment, and methods of operation applied in aviation and aeronautical industries.

Specific courses in subjects pertaining to aviation are offered in the Department of Mechanical Engineering, such as introduction to aerodynamics, applied aerodynamics, internal combustion engines; in the Department of Civil Engineering, fluid mechanics, structures, transportation design; in the Department of Electrical Engineering, electronics and communication, electrical circuits, all of which deal with principles and applications used throughout the different branches of aeronautical industries. The Department of Metallurgy teaches all engineering students in metals and alloys, and its own departmental students receive courses in general and advanced metallurgy and the broad techniques of this field which have increasingly important bearing upon materials and processes employed by aviation industries. In Chemical Engineering many of their courses necessarily include references to materials, processes, and procedures basic to the production of special fuels for use in aviation and the materials of construction.

In addition to the above, the School of Engineering conducted courses in flight training under the auspices of the Civil Aeronautics Administration as long as that program was in effect. Several hundred students participated.

The *Danbury State Teachers College* offers the following programs. In the laboratory schools the study of transportation is extended into the field of aviation which shows the influence of the airplane on industry and world

relations, emphasizing the interdependence of all people. This necessitates changes in the teaching of geographical concepts.

As the airplane has modified teaching, steamships and their routes, railroads, and transport trucks and buses will not be forgotten, but it will be shown how each of these great contributors to transportation supplement each other and how they may be used together within proper relationships. The goal of transportation is the benefit of humanity.

In the College two courses are offered in the field of aviation: meteorology and education for the air age. Previous to the war the *Danbury State Teachers College* taught the work in the ground school of the Civilian Pilot Training Program and hopes to continue this work after the war. The Danbury Airport nearby makes courses in aviation very attractive since the practical angle may be so easily emphasized.

Programs on Education for the Air-Age at *New Haven Teachers College* have been under way for five or six years. These have included emphases on aviation in connection with college courses in several fields, the Civilian Pilot Training Program sponsored by the Civil Aeronautics Administration, and the incorporation of air-age materials throughout the practice schools administered by the College.

In the summer school programs for the past several years increasing stress has been laid on air-age education in the science, mathematics, geography, and methods courses. A joint program has been conducted for the courses in library materials, geography, and world affairs, emphasizing "New Maps for the Air Age." Bibliographies, visual aids, and exhibit materials have been provided for the whole school so that a large variety of teaching aids are available.

Plans for the immediate future include several extensions of the current program. (1) Because faculty members feel inadequately prepared, several meetings will be held in which facts related to aviation and its impact on social, economic, and political life will be discussed. (2) Curriculum committees and individuals will then work these ideas more adequately into the training school and college curriculums, including the extension and summer school programs. (3) For the Service Center as well as the regular college program more teaching materials such as visual aids, units of work, special books, exhibit materials, and bibliographies should be provided. (4) Continued study of techniques and materials is planned.

The following are some of the activities at *Teachers College of Connecticut* at New Britain:

1. Civilian Pilot Training Program under the administration of the Civil Aeronautics Administration, which was conducted during regular and summer sessions prior to the war.

2. Courses in Aviation Education for elementary school teachers conducted through extension.

3. Public projects in airplane-model building conducted in connection with industrial arts classes.

4. Model building in connection with work in the elementary training schools.

5. Summer session courses, namely, (1) Elements of Aviation and, (2) Model Airplane Construction.

It is planned to have air-age education fuse into areas of study already in existence and to introduce any new phases, practical and desirable.

The *Junior College of Connecticut* at Bridgeport offers two types of training to students interested in aviation education. For those interested directly in the field of aviation, the College offers courses in pre-engineering and general engineering which are basic to a study of aeronautics, such as mathematics, engineering drawing, physics, and mechanics. The engineering courses also include a course in aviation ground school which is a study of Civil Air Regulations, aerial navigation, meteorology, and the general service of aircraft required by the Civil Air Regulations for a private pilot certificate. In the second place the College has organized other courses in the curriculums to reveal the influence of aviation upon subject matter and upon the social and economic habits of people. Units that depict these changed circumstances are found in history, geography, commerce, business, and transportation in particular.

The *Hillyer Junior College* offers two years of basic engineering training in the Day College, with electives in aeronautical engineering available from the Evening College. This curriculum is intended primarily for two types of students.

a. Those preparing to transfer to Senior Colleges of Engineering where they would major in either mechanical or aeronautical engineering.
b. Those wishing a two-year terminal engineering education preparatory to employment in the basic aircraft industries of Connecticut.

A program of basic engineering education, including electives in aeronautical science equivalent to two years of full-time study is offered in the evening. This program may be completed in four years of part-time evening study. This curriculum is of particular interest to those engaged in or who expect to be engaged in the technical or production side of our aircraft industries in greater Hartford. Other programs of study preparatory to becoming an airport manager, air traffic manager, dispatcher, or similar occupations, such as courses intended primarily to provide a sound basis for further personal flying, are offered to mature adults through evening classes.

*Hillyer* is not interested in offering training for the skilled aeronautical trades such as motor mechanic, rigger, fuselage expert, and instrument specialist, or for the most advanced fields of research and experimental work in the aeronautical world. The particular field of service performed by *Hillyer Junior College* lies between these two extremes.

The *New Haven Y.M.C.A. Junior College* has one major purpose, that of providing educational opportunities for employed men and women in southern Connecticut. Although the College is affiliated with both Yale and the YMCA, it is a separate corporation. Accordingly, it is accredited by the Department of Education of the State of Connecticut, and is degree-granting in its own right. Its plan of co-ordinating work and study is frequently referred to as the Work-Study Plan. Co-operative education has long believed that work experience is an adjunct to school experience—that education is best served by a combination of these. It insists that the student's work experiences and educational experiences should be integrated. In such a program, the student's work becomes a laboratory—one in which he is engaged daily.

For this reason, the new curriculum in aeronautical engineering will be open only to students employed in aeronautical industries. Actually, this curriculum is designed to meet the needs of men and women employed in Chance-Vought Aircraft and its affiliated companies.

In providing educational opportunities for men and women employed at Chance-Vought, the College proposes to "fit" its courses to the needs of students rather than to "fit" the students into courses. The College believes that in many cases this can best be accomplished by grouping students according to their educational background, and by developing "transitional courses" which will enable them to "round out" their education and to meet graduation requirements in a minimum of time.

The tentative aeronautical engineering curriculum includes English, basic mathematics, physics, advanced basic mathematics, mechanics, drawing and description, strength of materials, fluid mechanics, elementary aerodynamics, aircraft structures, advanced aerodynamics, and aircraft stress analysis.

The Committee recommends that aviation material be incorporated into the non-aviation subjects of the junior colleges in order that their students receive some preparation for the air age, and also that aviation science and social aviation courses be offered. Technical and semi-professional training of airport and airline managers, traffic controllers, and other officials, fits well into the terminal type of junior college where less than four years of college is needed, but men and women of high quality are desired for these positions. Those interested in airline sales work will profit from a year or two of college and some study of the economics of air transportation. Co-operative training programs between schools and industry are commended by the Committee.

Flight instruction up to solo, *i.e.*, eight hours or so of dual instruction, is recommended by the Committee for junior colleges, college, and university students. College credit should be granted for flying, which should be considered as laboratory experience in connection with general education in science. There are several reasons why junior colleges, colleges, and universities should sponsor flight instruction. It is invaluable experience for the aeronautics student who thus experiences the application of the theories he studies

in the classroom. It gives to all students an appreciation of flight and the possibilities of air transportation.

Furthermore, instruction sponsored by the college will be made available through licensed operators and licensed instructors, and the quality and safety of the instruction is therefore safeguarded. The automobile arrived without preparation of the public in the responsibilities of automobile driving. Our yearly automobile accident record testifies amply to this truth. Automobile safety education is not yet adequately presented to the public. In the case of the airplane, it would be well to develop flying in close connection with a safety education program, in order that the airplane may not become an even more fearful instrument of destruction than the automobile has proved to be.

Already public pressure has resulted in proposals to remove certain Civil Air Regulations controlling private flight, in order to stimulate an increase in such flying through the elimination of red tape and expense. An increase of unauthorized flight schools operated by more or less irresponsible operators is likely to accompany a general relaxation of safety rules and a vastly increased amount of civilian flight. The schools should thus assume more responsibility toward safety education for flight. It is the obligation of the junior colleges, colleges, and universities to co-operate with governmental agencies, reliable aircraft companies, and reputable flight schools, and to beware of fly-by-night enterprises with whom reliable schools will be in competition.

Pending financial assistance from public agencies, the junior colleges, colleges, and universities may assume part or all the expense of flight instruction and spread the cost over the student body, or may include it in the tuition fee, or may make the cost of flight instruction a laboratory fee. Perhaps some combination of these plans for financial support will be feasible in particular institutions.

## PENNSYLVANIA

DURING these past few years the trend of world events has clearly emphasized the influence of aviation in our lives, and out of this emphasis has come tremendous stimulation for development and expansion in aviation education. Many of the elementary and secondary schools of Pennsylvania introduced aviation materials and courses in pre-flight aeronautics following the publication of recommendations by the Pennsylvania Wartime Committee on Aviation Education in August, 1942. Since that time, annual Conferences on aviation education at the invitation of the Department of Public Instruction, have been made possible through the financial support provided by the American Council on Education.

A summary of the changing conditions and needs which now call for a re-examination of aviation courses on all levels, and the programs proposed to meet those needs, are herewith presented as the report of a three-day Conference on Aviation Education which was jointly sponsored by the Pennsylvania Aeronautics Commission and the Department of Public Instruction. Members of the Conference included teachers, supervisors, and administrators on the elementary, secondary, and college levels, airport operators, school directors, a representative of the Aviation Education Service of the Civil Aeronautics Administration, and staff members of the sponsoring agencies. The Conference report was prepared by Elizabeth Warnock, an experienced flight instructor and a teacher of aviation courses at Allderdice High School in Pittsburgh and at the University of Pittsburgh.

Teachers, administrators, school directors, and other interested groups in Pennsylvania are urged to study the report and to present comments and suggestions to the Department of Public Instruction. It is hoped that this report and the suggestions received following its publication may become the basis for a sound aviation education program for Pennsylvania schools.

**FRANCIS B. HAAS**
**Superintendent of Public Instruction**

### The Conference on Aviation Education

THIS REPORT[1] is an outcome of a Conference on Aviation Education held at Harrisburg, Pennsylvania, on August 8, 9, and 10, 1944, the third in a series of annual meetings of Pennsylvania state committees on aviation education. It is offered to public school officials and other educational authorities and interested persons as a guide in developing their local programs.

The members of the Pennsylvania Conference on Aviation Education believe that the future economic and political security of the nation depends to a significant degree upon our role in aviation, and that a successful aviation

[1] Prepared for the Committee by Miss Elizabeth Warnock.

program can be achieved only by the stimulation and with the approval of an interested and informed electorate.

As their guiding philosophy for aviation education, therefore, the members of the Conference are agreed that the primary responsibility of the public schools is to provide the type of instruction best suited to the development of a majority of citizens who are alert and informed about aviation, and that their secondary responsibility is to provide, where feasible, special instruction to prepare students for direct participation in aviation. Teacher-education institutions must prepare teachers for these purposes, and all colleges and universities must contribute to the development of consciously air-minded citizens by attuning their curriculums to the general needs of aviation education, as well as by expanding professional fields now offered, and by developing new fields as required.

Recommendations for the improvement of aviation education in the schools of Pennsylvania in keeping with this philosophy are presented in the report which follows. They are based upon a survey of experience with the present program and upon a careful consideration of changing needs and of world conditions. The background and present status of aviation education in Pennsylvania is first reviewed briefly in order that the source and direction both of commendable and of undesirable trends may be more clearly understood.

## DEVELOPMENT OF AVIATION EDUCATION IN PENNSYLVANIA

The teaching of aviation in the schools and colleges of Pennsylvania is not a new project. Well recognized is the work of pioneers on all levels. In the public schools, beginnings are officially recorded as early as 1924, though it is likely that aviation had been included in several vocational courses before that time. The 1930 report of a committee working under the auspices of the Daniel Guggenheim Fund for the Promotion of Aeronautics listed sixteen school systems of Pennsylvania as giving aeronautical instruction in some form or other. Aviation courses of a technical nature were offered by a few Pennsylvania colleges in the 1920's and in at least one university, aeronautical engineering became a regular four-year course before 1930. During the years before our entrance into World War II, scattered classes in Air Commerce, Air Navigation, Meteorology for Aviation, and the like appeared in college curriculums in answer to increasing general interest, but special courses for the training of public school teachers in aviation did not appear until 1942.

In Congress, motions proposing the teaching of aviation in the nation's public schools had been made sporadically since 1934, but it was not until 1939 that public concern for aviation education first made its demands effective nationally. Then it was the outbreak of World War II and the events immediately prior to it that focused attention upon aviation education's role in national security.

One of the first significant steps taken was the initiation of the Civil Pilot Training Program in 1939. In co-operation with colleges and universities and

private airport operators, the training of civilian pilots was begun under the direction of the Civil Aeronautics Administration. Federal participation in aviation education outside the military has been largely through the work of this agency in its development and extension of services for civil aviation. After our entrance into World War II, the Civil Pilot Training Program became the War Training Service, and remained under the direction of the Civil Aeronautics Administration. It continued to train aviation personnel for the Army and Navy until July, 1944, when the increased facilities of the military services themselves and the growing successes of our military campaigns permitted its termination.

From the inception of the Civil Pilot Training Program to the close of the War Training Service, 13,162 persons were trained in Pennsylvania under their direction. Fifty-six colleges and universities in the state co-operated with fifty-seven operators of airports and private aviation schools to provide the training personnel and facilities. In addition to the impressive fact of the numbers trained and their subsequent wartime service to aviation, these programs provided both incentive and aid to the development of aviation education in our public schools and colleges. In many Pennsylvania colleges, the experience and contacts developed have formed a basis upon which permanent aviation courses are now being built.

Aviation is expanding in the curriculums of Pennsylvania colleges and universities, and already several schools are offering majors in fields other than aeronautical engineering. Much of this is due to the stimulation of increasing general interest, but to an appreciable degree, it has been the result of the pressure of demands for the preparation of public school teachers of aeronautics.

The inadequacies of existing training were reported to Congress by the United States Commissioner of Education in 1941 with the statement that public education had not kept pace with the rapid development and progress of aviation. The statement was true of aviation education in the public schools of Pennsylvania too. Although aeronautics classes had been offered in the secondary schools of the state for more than fifteen years before World War II, they were few in number and sporadic in development. Many appeared to meet a brief flurry of interest, then died shortly as the interest waned or the teacher trained in aviation departed. By the fall of 1941, there were perhaps not more than twice as many classes being offered as had been listed in the 1930 report, although there was some evidence that a little aviation material had crept into other courses. In the 1941-42 term a decided increase was noted, but it was the fall of 1942 that saw the first tremendous expansion of high-school courses in Pennsylvania and throughout the nation.

The broad program for aviation education on the pre-college level, calling for the addition to the high-school curriculums of separate courses in aeronautics, and the inclusion of aviation materials in existing courses of the elementary and secondary schools, was developed in full strength during the

school year, 1942-43. The two greatest difficulties confronting the program were the lack of teaching materials and teachers prepared in the field. To meet these needs, texts and other materials were developed by research groups working at leading universities, lists of available teaching aids were compiled and distributed, aviation education conferences were held, and scholarships awarded to teachers. State education departments, colleges and universities, state and Federal aviation agencies, and commercial airlines provided significant help by one or more of these methods.

The Pennsylvania Department of Public Instruction, in May, 1942, arranged a conference to present to educational institutions and school officials proposals for aviation training in elementary and secondary schools. Shortly after the conference, the State Superintendent of Public Instruction appointed a Wartime Committee on Aviation Education and designated a staff member to co-ordinate the work in this field. The recommendations of this Wartime Committee and the services of the State Department in publishing and distributing annotated lists of teaching aids and source materials played an important part in encouraging the immediate expansion of aviation education in the schools of the state.

Many Pennsylvania high schools, further stimulated by increasing evidence of a growing need for pre-induction training in aviation, readjusted their schedules to offer aviation classes in September, 1942. The results of a questionnaire sent out by the State Department indicated separate aeronautics classes being offered in the 1942-43 term by approximately 400 high schools and the inclusion of aviation materials in other classes by over 300 schools.

Administrative hesitancy had been overcome by adjustments approved by the State Council of Education, the policy-making body for Pennsylvania public education. The Council designated the subject of aeronautics as a proper subject "to be included through adaptation of present courses . . . or to be taught directly as specific subjects." The problem of teacher certification was met by the further statement that "where a teacher holds a valid certificate to teach mathematics, science, or physical science, such certificates shall be valid to teach aeronautics if, in the judgment of the local superintendent, the teacher has demonstrated competence to teach this subject. Where a teacher is certified in secondary subjects other than mathematics, science, or physical science, and demonstrates to the local superintendent competence to teach aeronautics, such teacher may be certified for this subject on the basis of a statement of this fact by the local superintendent to the Superintendent of Public Instruction." These provisions have been reaffirmed and cover the certification of aeronautics teachers at the present time.

Teacher training has constituted a major problem. Less than one-sixth of the teachers assigned to aeronautics classes in September, 1942, had ever had aviation training or experience of any kind. Opportunities for Pennsylvania teachers to receive training in aviation before that time were limited to the

highly technical course offered in engineering schools, a very few scattered courses in colleges, the work in CAA-approved private aviation schools, and vocational evening courses offered in high schools of several of the larger cities. These vocational classes were chiefly shop courses and covered only one phase of the information needed by teachers.

At least one school of education and one teacher-training college in Pennsylvania were offering special courses in aviation for teaching during the summer of 1942. At the same time the Civil Aeronautics Administration provided aid by permitting public school teachers to sit in on existing CPTP ground courses without charge. A number of teachers took advantage of this offer. During the fall and spring semesters of 1942-43, the Civil Aeronautics Administration subsidized the preparation of secondary-school aeronautics teachers through courses offered at several Pennsylvania colleges. Another proof that a lack of aviation information was widespread, was that colleges were frequently unable to establish classes or were forced to discontinue them because adequately prepared instructors were not available. The United Airlines, through their School and College Service, early developed, collected, and distributed teaching aids, and during the summer sessions of 1942 and 1943 had provided scholarships for both elementary and secondary teachers at several Pennsylvania colleges and universities. Also a number of local school boards have financed the preparation of their teachers of aeronautics.

On the whole, a majority of aeronautics teachers, as well as elementary and secondary teachers of other subjects, have obtained information at their own expense, either from the beginning, or to supplement training begun under scholarships. Many are taking flight instruction. Several teacher-education colleges have facilities at nearby airports which have enabled teachers enrolled in aviation classes to secure flight instruction if desired. One school has arrangements for substantially reduced rates in flight instruction for all its students, and for a special inexpensive course designed for teachers, combining six half-hours in the Link Trainer and three half-hours of instrument flight instruction with ground work. In addition to other courses, it offers a workshop for experienced teachers who have had basic instruction in aviation.

Conferences have contributed largely to the development of aviation education in Pennsylvania. In January, 1943, a series of regional conferences discussed aviation as a part of the wartime education program for adjusting schools to the war effort. In June of the same year, a two-day conference on the teaching of aeronautics in high school was organized by the State Department of Public Instruction. The meeting was sponsored by the American Council on Education to study the problems encountered in what had been for most high schools a first attempt to teach aviation. The difficulties reported caused certain services to be provided in the succeeding months. Among the most popular of such services by the State Department has been its arrangement for the free use by teachers of the Pennsylvania Aeronautics Commis-

sion's Link Trainer and airplanes in a two-day course given at the Harrisburg Airport. Another significant indication of teachers' desire for more information was the interest shown in a Conference on Aviation Education held in March, 1944, by the School of Education of one Pennsylvania university. Its two-day program included addresses and panel discussions by national, state, and local leaders in aviation and education, an exhibit of aviation materials and teaching aids, a Civil Air Patrol Cadet Review, and an airport institute. Nearly 100 teachers of aeronautics, school superintendents and principals, and college faculty members attended the airport institute by invitation, some 150 attended the general meeting and Cadet Review, and more than 950 adults, many of them teachers, visited the exhibit.

During the 1942-43 school term, more than 8,500 boys and girls were enrolled in aeronautics courses in the high schools of Pennsylvania and many more have learned about aviation from new materials enriching other classes. In the elementary schools, the infusion of aviation information into existing courses has made significant progress. Serious problems have complicated the establishment of separate aviation courses from the beginning. School programs were not always sufficiently flexible to permit their introduction. Teaching materials were often inaccessible, unknown, or non-existent. Teachers were, for the most part, inadequately prepared in the field, if prepared at all. Similar problems in teacher-preparation and teaching materials confronted the integration programs of the elementary and secondary schools. Nevertheless, in spite of these difficulties, aviation education in our public schools has shown perhaps a far greater expansion than ever experienced by another school subject. World events have fully justified this expansion, and problems of future economic development and national security warrant even greater extension of education in this field.

### AVIATION EDUCATION IN THE ELEMENTARY SCHOOLS

We are nearing the end of a world war in which the final outcome will be determined to a large degree by air power. It has been said that much of the world's trouble is permitted to develop because of man's inability or disinclination to foresee the sociological changes his new material knowledge will bring. There is little doubt that our failure to understand and direct intelligently those changes which the airplane is making in our lives will affect our prosperity and our national security. Administrators and teachers have an immediate opportunity and an obligation to demonstrate their ability to anticipate social and economic changes and to prepare their students to meet them as they arise.

The ability to think and act intelligently about aviation is compounded of facts and understandings which must be drawn from many fields of knowledge. The responsibility for aviation education belongs to teachers in every subject field and on all levels. Since most children are interested in planes and how they fly, instruction properly begins in the elementary schools.

In response to the 1942 recommendations of the Wartime Committee on Aviation Education, more than 300 junior and senior high schools reported the introduction of aviation materials into various subject fields. A number of difficulties, including a lack of materials appropriate for the elementary level and a lack of familiarity with aviation developments and the possibilities of using aviation concepts, prevented elementary schools from making similar adjustments on any significant scale.

Nation-wide reports by elementary teachers from the kindergarten through the eighth grade who are teaching aviation as units or as other types of integrated parts of regular studies show how many approaches to aviation activities are clearly capable of furthering the universally accepted as well as the more progressive objectives of the elementary school.

*The present Conference believes that more specific objectives and more detailed reports of successful teaching practices in aviation on the elementary level are needed to increase the extent and effectiveness of the present program.* Two reports already completed offer definite and practical aid along these lines. The Stanford University Study[2] lists appropriate aviation materials by subject and grade level for both the elementary junior high school, and a report prepared and distributed by United Airlines describes successful practices used by elementary teachers from many parts of the country.[3]

*It is suggested that as a natural outcome of reading or discussion about airplanes, elementary teachers may guide children into such fruitful activities as the following: composition of original songs and stories about airplanes, rhythmic activities centered in aviation, construction work or painting of a nature to encourage creative expression.* These activities can lead to such desirable outcomes as increased oral and written vocabulary, increased interest and confidence in reading, improvement of arithmetic skills, development of self-direction, establishment of good work habits, and the elimination of the fear of flying.

*In the upper elementary grades, the use of aviation materials and activities may lead children to an appreciation of the responsibilities as well as the pleasures of living in a world made smaller by the airplane, to an understanding of the importance of scientific information, to an appreciation of the contribution of pioneers, in man's long struggle to fly, and to an understanding of the numerous examples of flight in the plant and animal kingdoms in developing the concept that flight is natural.* Pupils may be eager to use the basic skills of mathematics in solving aviation problems appropriate for their purposes. Even without encouragement students interested in aviation will become familiar with the vocabulary of aviation and with the related principles of science.

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[2] Stanford University, Stanford University, California.

[3] *How Representative Grade Teachers are Teaching Aviation.* Chicago: United Airlines, School and College Service.

*The Conference recommends that elementary teachers be encouraged to add to their authentic aviation information in order that they may work out their own sources and applications of aviation concepts. As they participate in the development of courses of study for their own schools, teachers may be expected to develop the interest and enthusiasm which will insure the effective introduction of aviation materials and experiences into elementary schools.*

*It is also recommended that consultant service in aviation be provided for elementary teachers through staff members of their own local systems, through the Department of Public Instruction, or through colleges.*

AVIATION EDUCATION IN THE SECONDARY SCHOOLS

The war has affected our educational system from the nursery school through the university, and its greatest change in the secondary school has been the rapid expansion in aviation education. More than 500 separate aeronautics courses are now offered in the high schools of Pennsylvania and aviation materials are included in many other classes.

In fulfillment of the recommendation by the Pennsylvania Wartime Committee on Aviation "that courses introduced during the emergency should not be continued beyond the emergency without careful examination of their relevance to emerging peacetime objectives," this Conference offers certain suggestions for the improvement of present practices in order that the vital contribution of aviation education to future economic and political security may develop a strong, effective peacetime program in keeping with the best modern educational philosophy.

The nature of the recent growth of aviation education in the high schools has permitted a number of trends to develop which appear as undesirable in a permanent program. Some confusion in aims, content, and method has arisen as a natural result of the speed with which aviation classes were introduced, and of the attendant problems in teacher preparation and teaching aids. This, together with the fact that pre-induction requirements, which played so large a part in initiating many aeronautics courses, are not identical with those of a peacetime program, point to the need for a number of readjustments.

*The Integration Program*

Although this program has made greater progress in the secondary than in the elementary schools of Pennsylvania, it is felt that the possibilities for the inclusion of vitalizing aviation information in social studies, sciences, mathematics, English and language arts, and fine arts have just begun to be realized. *The members of the Conference believe that the continued introduction of aviation materials into the various subject fields should be based upon careful planning in order to avoid undesirable duplication and superficial treatment.*

*Teacher committees can make valuable contributions in each district by analyzing integration materials to determine their value by subject and grade level.* The validity of the work will depend in part upon the aviation training

of the teachers concerned. An excellent study of this type for the elementary and junior high schools has been completed by a research group at Leland Stanford University.[4] It is suggested that the results of similar studies for the high schools be made available.

*A One-Year Course in Aeronautics*

If the high school is to play its part in preparing boys and girls to live a satisfactory life, it must prepare them to appreciate, to share, and to influence the contributions of aviation to our national future. The average high-school boy and girl are interested in aviation now, and they will continue to be interested in even greater numbers through their need for general information about an important phase of their daily life, and through personal piloting, flying as passengers, and jobs in aviation and related fields. Sixteen-year-old boys and girls are now taking flight instruction as civilian student pilots, and are receiving private licenses shortly afterward and commercial licenses at eighteen, an age when many are just completing the twelfth grade. Because of the greater numbers of teachers and subjects involved, and the freedom of choice permitted students in selecting classes in the upper grades of the typical high school, even the most successful integration program for the inclusion of aviation materials into traditional subjects will suffer considerable dilution in the program of an individual student.

The members of the Conference feel that there is a body of facts and skills about aviation which are timely and realistic for boys and girls in the eleventh and twelfth grades, and that these facts and skills can be taught effectively and efficiently only in a separate course. *It is their recommendation that the curriculums of Pennsylvania high schools should include, where possible, a one-year course in aeronautics elective on the eleventh- and twelfth-grade levels for any boy and girl whose program, interests, and abilities make it reasonably clear that such a course would be profitable. Special pre-requisites in mathematics and science are considered undesirable for this course, which is intended to be within the interests and abilities of the majority of the students.*

*It is recommended that the more technical phases of aviation be excluded in favor of a broader and more general treatment.* Present practice which includes an emphasis upon mathematics and science as pre-requisites and as a major part of the course content are felt to be unrealistic. The general criticism of such classes is that they exclude those very students who have the greatest need for securing practical, basic aviation information in high school, and, at the same time, do not properly substitute for the traditional mathematics and science backgrounds necessary for the limited group of students who may wish to prepare for further study in aeronautical engineering and similar professional fields of aviation. *For this reason also, the name Aeronautics is preferred to Science of Aeronautics or Science of Pre-Flight Aeronautics as the course title.*

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[4] Stanford University, *op. cit.*

It has been demonstrated that whatever mathematics and science is needed, the understanding of basic principles can easily be taught as a part of the aviation class itself, and that practical participation in aviation, especially as a pilot, does not require anything like the need for advanced science and mathematics which the average high-school teacher with no aviation background believes.

Personal piloting is a very real part of youth's share in aviation today, and its extension in the future is an assured fact. *For this reason the Conference members favor the inclusion of such materials in the one-year course in aeronautics as will provide adequate background for the practical demands of the private pilot.* It is felt that this is not in conflict with the previously stated recommendation that the more technical phases be excluded in favor of a more general approach for the reasons suggested in the paragraph above.

*The committee recommends that, as pre-induction needs lessen, all materials of an emergency nature be removed from existing courses and their general emphases be brought more in line with the newer philosophy suggested here. It specifically recommends that the study of radio code and of the identification of aircraft be eliminated from the course content.*

It wishes to call attention to the use of certain teaching devices, such as model building, out of all proportion to their appropriateness. The committee believes that model building will render greatest teaching value if used to supplement, to illustrate, and to encourage originality in general aviation courses.

*The members of the Conference do not favor the extensive use of the name "aviation" or "aeronautical" in the titles of courses where aviation materials are a superficial part of traditional subject matter.* It is recognized that the false impression of over-emphasis such practice gives, may bring criticism which can seriously hamper and even curtail a legitimate aviation education program.

There is included in this report a suggested outline for a course of study designed for a one-year course in aeronautics elective on the eleventh- and the twelfth-grade levels. It represents an attempt to present aviation materials needed to meet the broader educational aims of the newer philosophy without eliminating basic aviation information needed by private pilots and perhaps commercial pilots. An airport laboratory plan which includes four hours of flight experience may be made an integral part of this course wherever airport facilities are made available to schools.

*An Airport Laboratory Plan for the Course in Aeronautics*

The most effective learning is doing. For this reason, the course of study outlined for a high-school class in aeronautics is supplemented by an airport laboratory plan of ten lessons in addition to the other laboratory demonstrations and experiences suggested. Four of the lessons make use of the local airport's ground facilities only, and instruction is under the direction of the

high-school class teacher and the airport personnel, which, in the case of major air terminals, will include representatives of government agencies located there. It is felt that, in the interest of furthering intelligent use of their services, Federal and state governmental aviation agencies as well as airport operators will welcome such supervised groups. This has been the case where similar plans have already been tried. Again it should be noted that sixteen-year-old boys and girls are now flying under civilian student permits at their own expense, and are securing private and commercial licenses at eighteen. Present plans call for the reduction of the age minimum for private pilots to little more than sixteen. It is only reasonable to expect the end of the war and the further lowering of flight restrictions to find many more of high-school age flying.

Six of the airport laboratory-plan lessons are based upon actual flight experience in light, dual-controlled airplanes with appropriate instruction by a properly certificated flight instructor before, during, and after flight. The time in the air allotted to each lesson varies from twenty minutes for a demonstration of weather effects to ninety minutes for a cross-country navigational trip. Three lessons of thirty minutes each and one of forty minutes bring the total time for flight experience to four hours. Since flight conditions are often unpredictable, these time allotments are suggested as a guide and should be adjusted as thought proper.

This flight experience is definitely not intended to parallel the usual four hours of flight instruction given before solo, which are necessarily repetitions of primary maneuvers to achieve minimum skills. Rather, these lessons are intended to provide students with an opportunity to experience practical application of the principles studied in the high-school aviation class. As outlined here, they also cover those principles which are the background of the aviation knowledge of private and commercial pilots. Airport operators in general do not consider this type of laboratory flight experience as undesirably competitive with or repetitious of present methods of flight instruction even on controlled programs. They welcome the additional judgment its understandings will develop in future pilots. Many operators have expressed concern over the lowering of age minimums and lifting of flight restrictions which will bring increasing numbers of pilots in the lower-age brackets, for safe civilian flying depends far more upon good judgment than upon faster youthful muscular reaction time. There is also a feeling that local expediency, governed by financial and other arrangements with local operators, should determine whether or not this laboratory flight experience should be logged as flight instruction prior to solo in the conventional manner.

The airport laboratory instruction is to be given at intervals during the two semesters of the aeronautics class, and is arranged so that each ground and flight experience follows the regular class study of the materials and principles involved. In order to take advantage of the more satisfactory weather

conditions during Pennsylvania school terms, the course of study has been so arranged as to permit most of the ground work and all of the flight experience to be given during the fall and late spring or early summer. No special note is made of points to be discussed in the high-school class after each laboratory lesson at the airport, as it is understood that the regular class review can make use of the post-flight suggestions for the flight instructor and of the items checked on each student's log. A suggested student log to be checked and signed by the proper airport instructors, then turned over to his high-school teacher by the student after each individual lesson, is included in this report.

As the airport laboratory classes will probably be scheduled after school hours and on Saturdays at the convenience of the airport operator, considerable responsibility rests with the high-school class teacher for making sure that none but *bona fide* class members take part, and that members understand none may request these special privileges at other times except with his express permission. It has been suggested that a student identification card might be issued for this purpose.

*Student Qualifications*

It is understood at this time that the suggested airport laboratory plan is entirely optional with the student, and that his failure to take part in it will in no way affect his academic standing in his high-school course in aeronautics. It is also understood that students wishing to participate in the laboratory plan must have the written consent of their parents or guardians, and, if they are to take the opportunities for flight experience, must also prove their physical condition satisfactory by the standards set for CAA student permits or others approved by the school. No further restrictions upon student participation other than satisfactory standards of accomplishment in the regular high-school class and proper use of the airport privileges seem advisable.

*Financing*

The ground instruction of an airport laboratory plan will involve little or no expense beyond that required for transportation which, in most cases, can be secured without difficulty. It would seem that existing methods used by any particular school to finance its transportation of other student excursions might be applied without question to its transportation of students to and from the airport.

The flight experience of four hours, however, will involve costs up to an average ceiling of $10 an hour for each student, depending upon local price schedules and special arrangements made with the airport operator. It appears that, at the present time, no state or Federal funds are available to pay for this laboratory flight experience. It is recognized that this is a pioneering educational program and that it may be necessary to use a variety of private financial sources. Service clubs, civic clubs, aero clubs, student associations, and other private and corporate philanthropists may supplement or replace the funds of individual students.

*Liabilities*

The question of liability arises especially in connection with the flight experience program as it does with school athletic programs and, in fact, all school activities. A pattern of procedures for contract-making between schools and flight operators has been worked out by Pennsylvania colleges and universities. It provides adequate liability protection for the schools and has been practiced by them with success during Civil Pilot Training Programs in this state. As the laboratory plan suggested here is optional and may be financed by private means, it is possible that a sponsoring agency may wish to make such a contract itself. Under present approved practice which requires that instruction should be given in a light airplane with dual controls, the flight operator shall agree to the following conditions:

1. To maintain an approved flight school according to the requirements of the Civil Air Regulations
2. To maintain an insurance policy to cover public liability and property damage which shall hold and save harmless the flight-school instructor, the school district or sponsoring agency, the board of directors or officers and board of the sponsoring agency, and the trainee. The minimum limits of this policy should be $50,000/$100,000 public liability and $5,000 property damage
3. To provide insurance for the trainee in the amount of $3,000 in case of death and $500 hospital and medical expenses for injury
4. To provide a proper number of flight instructors and of airplanes to maintain an approved student-instructor ratio
5. To refuse further flight instruction to students when they become hazards to persons or property.

The contract provisions suggested above are ordinarily sufficient to protect adequately the school or sponsoring agency and to prohibit the shifting of responsibility for negligence upon the part of the flight instructor or the flight operator to the school district or the agency. However, there is no intention in this report to dictate policies for contract making, for it is obvious that the exact form and provisions of such contracts must be the subject of careful legal consideration by both of the local parties concerned. The assumption of the costs of liability protection by the flight operator is traditional, as he is operating a private enterprise for profit and, therefore, not entitled to the legal immunity accorded school boards in relation to their governmental activities.

If teachers employed by a local school board are to serve also as flight instructors, special provisions must be made to obtain insurance to cover personal liability they may incur, for teachers are ordinarily responsible for damage caused by their own negligence. Because of such problems in insurance and liability and because of maintenance difficulties, it is not thought advisable that school-club airplanes be used for flight-experience lessons. In such school districts as operate a completely equipped and fully CAA-certificated mechanic

school and repair station with school-owned airplanes, the situation would be quite different.

### VOCATIONAL INDUSTRIAL EDUCATION IN AVIATION

Vocational industrial education embraces both trade-preparatory (pre-employment) and trade-extension (supplementary) instruction. The former, in general, prepares young men and women of secondary-school age for advanced apprenticeship in skilled trades or crafts. This type of instruction requires extensive facilities and vocationally competent instructors. In trade-preparatory education, the content, the location of training centers, and the numbers to be trained are all closely associated with job opportunities, and, since the major part of the day is to be spent in intensive preparation for entrance into an occupation, careful selection of students is essential. School administrators are inclined to be conservative in establishing all-day trade units of instruction for occupations which may not admit of detailed analysis of future employment opportunities such as aviation, or which do not, at the present, warrant extensive training.


**Reading left to right we find Mary Lou Forst recording barometric pressure, James Mumphrey inking the pen of the thermograph, and John Rearden reading sling psychrometer. All are students of the Isaac Young High School, New Rochelle, New York, aviation education classes.**

*It is important, however, that a limited number of trade-preparatory and vocational-technical courses in aviation be conducted so that tested knowledge may be applied to the further development of vocational education when job opportunities in aviation encourage more extensive facilities. It is recommended that advisory committees representing education, employers, and employees should participate in surveys of vocational training needs in aviation fields.*

*Utilization of Present Facilities*

Vocational auto-mechanics courses provide fundamental instruction in the operation, maintenance, and repair of internal combustion engines, principally of the multi-cylinder in-line type used in automobiles. Much of the technical information and practically all of the manipulative skills and judgments apply to the work of the aviation engine mechanic.

*It is suggested that, as commercial airports and the repair and maintenance of private airplanes in licensed repair stations provide job opportunities, the inclusion of training in the repair and maintenance of the "smaller" aircraft engines as a part of existing vocational auto-mechanics courses be considered. In the event that this becomes effective, provision should be made for training and licensing auto-mechanics instructors to handle this added training responsibility.*

*Where the need is substantiated, consideration should be given to the adjustment of existing vocational-industrial courses to include aviation applications in keeping with the respective craft or trade.*

*Part-Time Co-operative Industrial Education*

*Where desirable work opportunities in aviation are available, effective vocational instruction may be presented to advanced students by organizing a program whereby half of the school period is spent in selected employment and half of the time is devoted to related technical instruction and the completion of the general education requirements of a secondary school.* Thus the manipulative skills and job experience are provided, under close supervision, at an airport or at a maintenance and repair shop, and the supporting technical instruction and background of related information is presented at the school by specially prepared instructors. Limiting factors in part-time vocational instruction are job opportunities and the age at which students may enter co-operative employment.

*Vocational-Technical Instruction*

*Although experience in vocational-technical instruction for students who are preparing for employment in aviation is limited, this type of vocational education deserves careful consideration, especially so, if a school district finds it feasible to extend instruction to include the thirteenth and fourteenth years.*

*Part-Time and Evening Vocational Extension Instruction*

Adult vocational education including related instruction for both apprentices and skilled workers provides a flexible, responsive program which is readily adaptable to changing training needs. The effectiveness of this type of

program is readily observed, since attendance is voluntary and the applicability of instruction influences attendance.

*It is suggested that provision be made for the re-training and up-grading of auto mechanics, apprentices, and partially trained aircraft engine mechanics who are employed as aircraft engine mechanics. It is recommended also that consideration be given to the establishment of short-term training courses and programs, where needed, to train persons who are employed in aviation maintenance and repair occupations.*

*Teacher Certification*

The members of the Conference believe that policies regarding the certification of teachers of aeronautics in the public schools of the state must be revised in order to assure higher standards and broader preparation. The working of the present emergency provisions has resulted in an unwarranted emphasis upon the role of science and mathematics in the content of aeronautics course. A majority of Pennsylvania superintendents and principals, because of this certification statement, assigned their aeronautics classes to science and mathematics departments. The natural effect was to produce, in too many cases, classes of mathematics and physics faintly tinged with aviation, under the names of aeronautics classes. Their major emphasis upon formulas and problem solving is not justified by general practice in aviation itself. While it is most desirable to have aviation materials enrich mathematics and science courses as a part of the general integration process, such classes should not be mistaken for courses in basic aviation materials.

The selection of mathematics and science teachers for aviation classes has also contributed to the setting-up of unwarranted pre-requisites. There would seem to be no justifiable reason why the average high-school boy or girl seeking basic aviation information should first be required to take physics, trigonometry, or astronomy, as suggested in one case. Extensive research studies conducted during the past year have proved that success or failure in aviation classes as now conducted has not depended upon such pre-requisites, and existing courses are more academic along such lines than now thought desirable.

*The Conference recommends that the State Council of Education be asked to clarify its statement so that the Superintendent of Public Instruction is authorized to assign the teaching of aeronautics classes to any certificated teacher, elementary or secondary, who has shown an interest in this field and who, in the judgment of his superintendent, has demonstrated competence to teach the subject. Such authority would continue until a sufficient number of adequately trained teachers are available. At that time due consideration is to be given to teachers who have demonstrated competence by teaching, and reasonable credit offered for that teaching in meeting permanent certification requirements.*

AVIATION EDUCATION IN COLLEGES AND UNIVERSITIES

*Preparation of Teachers*

The success or failure of all educational programs on the elementary and secondary levels depends, in the end, upon the preparation of their teachers. The responsibility for this preparation belongs to the colleges and universities. As a result of the rapidity of the recent spread of aviation education at the lower levels, especially in the secondary schools, the problem of developing and offering adequate preparation in this field has been a difficult one. In spite of their own lack of trained instructors, their unusual wartime administrative problems, and the general confusion in aims, a number of Pennsylvania colleges already have excellent programs in operation. In the approaching transition period between war and peace and in the postwar period, alert and competent leadership in aviation education must be asserted or the future will lose even those gains the war has forced. Increasing responsibility must be assumed by colleges and universities for developing a progressive philosophy of aviation education, as well as for expanding fields of study, and improving teaching techniques.

As a result of their survey of present practice, the members of the Conference feel that a broader program of teacher education is needed for all elementary and secondary teachers as well as for those secondary teachers who will have separate courses in aeronautics. To encourage its development in line with the best modern thinking in aviation education, the Conference agreed upon the following suggestions for the improvement of the present program.

1. By present standards, the existing outline of courses constituting a field of certification in aeronautics in Pennsylvania state teacher colleges, is not broad enough in its selection of elective or required courses. The Conference does not wish to recommend a definite outline of courses or to assign credits to such courses at this time. It feels that further experience with aviation education programs at all levels is desirable before a permanent plan be set up. *It does wish to recommend, however, that future certification fields include such courses as the economics of air transportation, global geography, and courses of a broader cultural nature which are closely related to the newer emphases in the secondary schools. It also proposes the following changes in courses now listed. Aircraft engines should be replaced by power plants in order that the study of propellers and other features for which no provision is made elsewhere be included. Communications, which are a logical part of navigation information, should not be taught as a separate subject, nor, as military demands decrease, does there seem to be any valid reason for the inclusion of radio-code practice as a part of its content. Identification of aircraft, which has also been a temporary military need, should now be eliminated. Civil Air Regulations can more logically and effectively be incorporated in other*

*aeronautic subjects where individual sections can be given in closer conjunction with their appropriate references. Aviation mathematics should be discontinued as a subject. In most cases the requisite mathematics can be taught as an integral part of the aviation courses concerned. Where additional mathematics appears essential, the committee is in favor of offering it under the traditional names.*

2. *In order to implement the program for the integration of aviation materials in other subjects of the elementary and secondary schools, the Conference recommends that courses offered for the preparation of teachers in fields other than aeronautics be examined, and where necessary, revised to emphasize appropriate implications of aviation.*
3. *To the same end, it is further recommended that opportunity and encouragement be given teachers of subjects other than aeronautics, to seek additional preparation by taking other specific aviation classes.* The social studies teacher may well profit by a course in the history of air power, or one in air transportation. The science teacher will be more effective if he has a more thorough knowledge of meteorology and of aerodynamics. And the mathematics teacher will find a whole new field from which to choose his illustrative problems for higher mathematics in more advanced navigation classes.
4. *The Conference recommends that laboratory flight experience be provided as a regular part of appropriate classes, to the extent of a total of six or eight hours. This flight experience should be given to supplement those stages which, in the work of the classes in which it is used, will make it most effective as a teaching device.*
5. *To increase the effectiveness of present aviation instruction, the committee suggests that state-supported and state-aided teacher-education institutions should provide consultant service in aeronautics, and recommends that the state provide sufficient subsidy for the purpose.*

*Other Programs*

*It is recommended that colleges contribute to the general aims of aviation education by making significant aviation concepts an integral part of their existing courses, and by developing courses of a general cultural nature.*

*Where the need is substantiated, present professional fields should be extended and new ones developed.*

*It has been suggested that consideration should be given by colleges to voluntary programs for the training of military aviation personnel during peacetime, possibly after the pattern of existing Reserve Officer Training Corps Programs.*

AVIATION EDUCATION SERVICES BY THE STATE DEPARTMENT OF PUBLIC INSTRUCTION

The members of the Conference feel that the *Airport Operations Institute* for teachers and administrators has proved a most effective means of pro-

moting enthusiastic understanding of certain purposes of aviation education. *They suggest that, where possible, a series of such institutes be held throughout the state in conjunction with teachers' institutes, the Pennsylvania State School Directors' Convention, and other educational meetings.*

*As a further service, the Conference members recommend that the State Department of Public Instruction continue to compile and distribute bibliographies of aviation teaching materials and, where feasible, provide itinerant consultants in aeronautics for elementary and secondary schools.*

*It is the belief of the Conference that co-operation with local, state, and national organizations and agencies interested in aviation is desirable. It is felt that such co-operation can be mutually helpful and can prevent duplication of aviation training programs in communities.*

## A One-Year High-School Course in Aeronautics

### UNIT I

PROBLEM I. *What Does Aviation Mean?*

A. To what extent is aviation a personal and a commercial means of transportation?
   Comparison of airline with other types of commercial transportation; statistics for mail, freight, and passenger carrying; comparison between private and commercial airline flying as to planes and pilots involved (ratio fifty to one before the war, 200 airline planes in U. S. before the war); 3000 civilian student pilot licenses[5] issued monthly by the Civil Aeronautics Administration last year.

B. For what civilian purposes other than travel and mail and freight carrying are aircraft used?
   Aerial photography; aerial surveying; mapping; fire patrol; customs and immigration patrol; police work; aerial advertising; crop-dusting; ground traffic direction; rescue work; weather observations; scientific observation and experimentation.

C. How important is aviation in our economic life?
   Employment and capital investment in aircraft industries, related industries, commercial airlines, private aviation, airports, sales, promotion, and other activities; reconversion and probable postwar status of the aircraft industries; postwar developments.

D. How has aviation been a vital factor in waging war?
   Offensive and defensive air power; supply systems for men and material; artillery observation; convoy protection; submarine patrol; rescue work; air evacuation of wounded.

Types of Class Demonstrations:
   Films

[5] Because of secrecy surrounding wartime activities, some statistics will be pre-war. In Pennsylvania, the latest report available, that of 1941, shows a greater number of airports and a greater number of private aircraft registered than in any other state.

*Sky Riders,* 16-mm. sound, 10 min. Rent from YMCA

*The Development of Transportation,* 16-mm. sound. Rent from Encyclopedia Britannica Film, Inc.

Types of Student Activities:

Review outstanding books on the role of air power in future peace and war. Consult bibliography for titles.

Report on interviews with local leaders in civil aviation and with military personnel.

PROBLEM II. *How New Is Aviation?*

A. For how long had man been trying to fly before he met with success?
Ancient legends; Bacon's scientific approach; the versatile DaVinci; development of the balloon, airship, glider, and airplane; Sir Hiram Maxim, Clement Ader, Samuel P. Langley, and the Wright brothers.

B. What progress had been made up to the time of the first World War?
Bleriot's flight across the English Channel; aviation's first boom in 1909; the creation of England's Advisory Committee for Aeronautics in 1909; the creation of the National Advisory Committee for Aeronautics by the United States in 1915; Glenn Curtiss and the flying boat; first use of radio from a plane; first air mail carried in 1911; first large landplane, Sikorsky's "Aerobus" in 1913; airplane rides and the flying circus as publicity stunts.

C. How did the first World War advance aviation?
Military personnel impressed with aircraft as a weapon of war; experimentation and use improved the airplane and its engine; reservoir of planes and trained personnel aided in the development of private and commercial aviation; interest in trans-Atlantic flying revived.

D. In what ways has World War II speeded development?
Production of aircraft increased far beyond previous conjecture; standardization of parts has speeded production, repair, and replacement; new programs of research and experimentation improving design and construction; war offering unparalleled opportunities for testing new ideas and inventions.

E. Has World War II changed any former beliefs?
Need for getting men and supplies to distant fronts opened new transportation routes formerly considered too long and too dangerous; size and useful load of planes increased far beyond what had been considered the limit of safety; the primary importance of aviation in waging war and in safeguarding peace confirmed beyond doubt.

Types of Class Demonstration:

Films

*History of Aviation,* 16-mm. sound, 30 min. $4.50. Rent from Gutlohn, Inc.

*Conquest of the Air,* 16 mm. sound, $10.00. Rent from Films, Inc.

Film Strips

*Men and Wings,* $3.50. Purchase from Jam Handy Organization.

*Today's Wings,* $3.50. Purchase from Jam Handy Organization.

Radio Scripts

No. 432, *Aircraft in the World War*

No. 436, *Modern Wings for Commerce*

Both from Transcription Exchange, U. S. Office of Education, Washington, D. C.

Types of Student Activities:

Collect pertinent magazine and news articles for class report and for display on the class bulletin board.

Read and report upon the pamphlet *The Measure of America's World War Aeronautical Effort,* by Colonel Edgar Gorrell, Norwich University Press, Northfield, Vermont, 50c.

PROBLEM III. *What Has Been Done by State and Federal Governments to Promote Safety in Aviation?*

A. What early legislation took steps to promote safety?
Early state legislation; state licensing of pilots; The Air Commerce Act of 1926, providing for the laying out of airways, the enforcement of flying rules, and the Federal licensing of pilots; continuation and expansion of work of National Advisory Committee for Aeronautics first established in 1915.

B. What additional action was taken to improve conditions?
Civil Aeronautics Act of 1938 with subsequent revisions in 1940 creating the present independent Civil Aeronautics Board, and Civil Aeronautics Administration under the Department of Commerce: present Pennsylvania State Aeronautics Commission.

C. What other Federal agencies co-operate with the CAB and Civil Aeronautics Administration to help give advice, information, and service for the safety of the plane, crew, and passengers?
National Advisory Committee for Aeronautics; U. S. Weather Bureau: U. S. Coast and Geodetic Survey; the military service; manufacturers of aircraft; airline transport companies.

D. May any person fly who has learned to control a plane?
Certification of all pilots by the CAA or military services; types of certificates, requirements and privileges; military pilots and CAR.

E. What procedure may be followed locally by persons who want to learn to fly? How expensive will it be?
Location of airports giving flight instruction; test flights; local instruction rates; approved CAA courses; airplane clubs; private ownership of airplanes, their purchase, certification, hangaring, as well as their maintenance.

F. May a pilot fly at any time or place in any plane?

Approval of airports by state and Federal agencies; restricted areas; traffic control areas; acrobatic flight; flight on and off the airways; over-the-top flight; weather minimums and flight rules for contact, instrument, and closed weather conditions; night flying; competency of pilot; registration and airworthiness of aircraft.

G. What other rules does a pilot need to know before he leaves the ground?
Inspection of aircraft; fuel requirements; supervision of running engines; flight permission; procedure for takeoff and landing; right-of-way and proximity in flight; minimum and maximum safe altitudes; approved flight areas; weather classification; lights and signals; use of parachutes.

H. During times of good weather, on "contact flight" what navigational aids help prevent pilots from becoming lost?
Broadcasts of weather information; maps, lighted and marked airways; airway traffic control; airport traffic control; lights and signals.

I. What additional aids are provided for "instrument flights"?
Radio range systems; radio marked beacons; instrument flight altitude rules.

Types of Class Demonstrations:

Films

*Safety in the Air,* 16-mm. sound. Rent from Films, Inc.
*Learn and Live,* 16-mm. sound. Rent U. S. Army Film.
*Airways Flying,* 16-mm. sound. Rent U. S. Army Signal Corps, TF.

Film Strips

*Traffic,* Jam Handy Organization.
*Airway Aids,* Jam Handy Organization.
*The Pilot,* Jam Handy Organization.

Airport Laboratory Plan:

LESSON 1: *Familiarization Tour of Local Airport, No Flight Experience Included.* (See pages 174-75.)

UNIT II

PROBLEM 1. *How Do Aircraft Fly?*

A. How do lighter-than-air craft differ from heavier-than-air craft?
Flight principles, general construction, uses, and limitations of balloons, airships, gliders, and airplanes; of helicopters, autogiros, jet or exhaust propelled planes, and of rocket planes.

B. Upon what scientific principles do they depend for flight?
Differential pressure; Bernouilli's principle; Newton's laws; the four forces that act upon an airplane in flight; use of wind tunnel for scientific testing.

C. What are airfoils?
Definition—examples; the wing as the principal airfoil of the conven-

tional airplane—leading edge, trailing edge, span, chord, tip, camber, streamlining.

D. What are the principal parts of the conventional airplane and what purposes do they serve?
Wings, fuselage, powerplant, empennage, alighting gear, controls and control surfaces.

E. What factors affect lift?
The air ocean, variations in density due to temperature and altitude, the purpose and meaning of altimeter readings; velocity of flow of air against the airfoil, purpose and meaning of airspeed indicator readings, airspeed *versus* ground speed; shape, size, area, and aspect ratio of wing and other airfoils; the angle of incidence and the angle of attack, the burble point, the stalling angle; relation of thrust and drag to lift.

F. What is drag and how can it be reduced?
Induced, profile, parasite drag, skin friction; eddying or burbling, wing-tip vortices, plan form, and aspect ratio of wings; streamlining, stagger.

G. How is a plane given thrust?
Power and the factors affecting it; the propeller as an airscrew; thrust in a glide; purpose and meaning of tachometer, oil temperature, and oil pressure gauge readings; L/D ratio.

H. How can lift be varied during flight?
Variations in airspeed and angle of attack; the stall; high-life devices, the slot and the flap; tabs and stabilizer.

I. How is an airplane controlled in flight? What are its principal movements?
Vertical, lateral, and longitudinal axes of movement; yawing, pitching, and rolling or banking; use of the controls; pressure exerted, not travel of control, determining amount and speed of response; necessity for co-ordination of control movements, slipping, skidding.

J. What are the principal maneuvers of a plane and how are they accomplished?
The takeoff, the flight, and the landing; straight and level flight, the climb, the glide, the turn; combinations such as the climbing turn and the gliding turn; flight instruments.

K. What daily check is made to determine whether the plane is in safe condition to fly? Who makes it?
The line inspection by a certificated mechanic, a pilot of private grade or higher, or under their supervision.

Types of Classroom Demonstrations:
Demonstrate Bernoulli's Principle by means of an atomizer and ping-pong ball supported by a column of air.

Demonstrate Bernoulli's Principle by blowing into an inverted funnel holding a light ball, or by blowing over a light piece of paper held against lower lip. Use class-constructed wind tunnel to demonstrate lift and drag with different shapes of airfoils, and to demonstrate factors varying lift.

Use a jet of air over an open bottle of dry ice to make visible the airflow over flat plate, round, and streamlined objects and to demonstrate the burble point and the effect of slots.

Films

*Aerodynamics: Theory of Flight,* 16-mm. sound, 11 min. Rent from Erpi Brothers.

*Aerodynamics: Problems of Flight,* 16-mm. sound, 11 min. Rent from Erpi Brothers.

*Aerodynamics:* Part I, *Properties of the Air,* 16-mm. sound. Rent from Bray, $2.00.

*Aerodynamics:* Part II, *Lift,* 16-mm. sound. Bray, $2.00.

*Aerodynamics:* Part III, *Air Resistance and Streamlining,* 16-mm sound. Bray, $2.00.

*Flight Maneuvers: Aircraft and How They Fly.*
*Flight Maneuvers: Motions of a Plane.*
*Flight Maneuvers: Starting, Taxiing, Taking Off.*
*Flight Maneuvers: Flying the Turn.*
*Flight Maneuvers: Landing.*
Each, 16-mm. sound, 11 min. Rent from Bray, $2.00.

*Youth Takes to Wings,* 16-mm. sound, 60 min. Rent from Bray. (Contains excellent ideas for demonstration devices and laboratory experiments that students can work out later.)

Film Strips

*Lift and Drag*
*Wing Forces*
*Flight Instruments*
*Check and Double Check.* Each $3.50. Purchase from Jam Handy.

Types of Student Activities:

Construct a wind tunnel in co-operation with other class students. Use plans such as those given in the *Science of Pre-Flight Aeronautics,* the Teachers' Handbook for *the Elements of Pre-Flight Aeronautics for High Schools, Current Aviation,* or design original plans. Demonstrate aerodynamic principles with the wind tunnel. Use traditional types of airfoils and design new ones.

Airport Laboratory Plan:

LESSON 2: *Tour of the Hangars and Inspection of Aircraft for Parts and General Construction, Line Inspection, No Flight Experience Included.* (See page 175.)

LESSON 3: Familiarization with the Airplane on the Ground and in the Air, Thirty Minutes of Flight Experience Included. (See pages 175-76.)

PROBLEM II. *How Is the Task of Controlling the Plane Made Easier for the Pilot?*

A. What are the principal aids which supplement the normal controls?
Stabilizers, trimming tabs, balanced controls, slots, flaps; inherent stability of aircraft.

B. What are the different kinds of stability? Which are desirable in an airplane and why?
Inherent stability; dynamic stability; positive, negative, and neutral stability; lateral, directional, and longitudinal stability.

C. How are aircraft made stable?
Determination of center of gravity and center of pressure; importance of their relation; dihedral; sweepback; torque effects; wash in and wash out of wings; keel effect; side area in relation to center of gravity; relation between stability and maneuverability; sacrifice of stability for maneuverability in military planes; non-spinnable planes.

D. Why are stalls and spins important in the flight characteristics of a plane?
Normal spins and stalls and recovery; accidental stalls and spins, entrance and recovery; abnormal spins and stalls; importance of loading plane according to specifications to prevent abnormal spins and stalls; necessity for altitude in recovery from stalls and spins; safety factor in stability, normal commercially certificated light planes will recover from stalls and spins "hands-off" if there is sufficient altitude.

Types of Class Demonstrations:

Demonstrate the use of trimming tabs, stabilizer, and fin adjustment by means of a model in the wind tunnel.

Use model plane to demonstrate the three axes of movement and the types of stability.

Demonstrate stability with flying models or with pieces of cardboard bent and weighted.

Films

*Aerodynamics: Problems of Flight,* 16-mm. sound. Rent from Encyclopedia Britannica Films, Inc. Purchase price, $45.00.

Film Strip

*Stability,* $3.50. Purchase from Jam Handy.

Types of Student Activities:

Build a flying model to illustrate all the desirable types of stability.

Design and build a non-spinnable flying model.

Originate a demonstration device to show stall and spin recovery "hands-off" after a minimum dive and a minimum number of spins,

corresponding to the performance of a typical commercially certificated light plane.

Airport Laboratory Plan:

LESSON 4: *Demonstration of Stability in Airplanes, Thirty Minutes of Flight Experience Included.* (See pages 176-77.)

PROBLEM III. *What Are the Personal Effects and Limitations of Flying?*

A. Why can the average healthy person enjoy flight as a passenger or as the pilot of his own plane without experiencing unpleasant or dangerous physical sensations?

Flights normally made at relatively low altitudes; abnormal flight maneuvers not performed deliberately except to practice for flight tests and to learn characteristics of a particular plane; abnormal maneuvers unlikely to be performed accidentally if pilot-competency rules, aircraft airworthiness regulations, and weather minimums for flight are observed; non-spinnable planes now eliminate need for or possibility of spins.

B. What are the minimum physical requirements for student, private, and commercial civilian pilot certificates? What are they for military services?

Secure Part 29, *Physical Standards for Airmen,* Civil Air Regulations, Superintendent of Documents, Washington, D. C.

Secure latest recruitment literature or consult representatives of military air forces directly.

C. What are some of the effects of altitude?

Effects of change in atmospheric density upon respiration; altitude sickness; aeroembolism; flight fatigue.

D. What are the personal effects of violent acrobatic maneuvers?

Loss of orientation; blacking-out; airsickness; loss of muscular coordination; acceleration effects; fatigue.

E. Why should persons not fly when they are not in good physical condition?

Effects of respiratory diseases—colds, sinus infections, hay fever; effects of physical fatigue.

F. It has been said that the only limit to the possibilities of flight is the human physique. What is being done to help man keep pace with his aircraft?

Pressure cabins and pressure suits for altitude; electrically heated suits for altitude; automatic devices for dive-recovery; and many other newly developed devices.

G. What precautions will contribute to the physical enjoyment of flying as a passenger or as a pilot?

Avoid flying when ill or fatigued; avoid flying after ill-chosen meals; during flight "ride with the ship," keeping safety belt tight enough

to hold a firm seat, especially in bumpy air; learn and practice proper methods of orientation in spins and other unusual maneuvers.

Types of Class Demonstrations:

Demonstrate typical tests for physical fitness in aviation such as those found in *Are You Fit To Be a Pilot* by Ermin L. Ray and Stanley Washburn, Jr., Wilfred Funk and Company, New York, 1941.

Have students recount physical sensations experienced in flight; discuss reasons; suggest correction, if possible.

Types of Student Activities:

Construction apparatus for the measurement of depth-perception.

Demonstrate apparatus by testing class members.

Airport Laboratory Plan:

LESSON 5: *Demonstration of Variation of Lift, Thirty Minutes of Flight Experience Included.* (See page 177-78.)

UNIT III

PROBLEM I. *How Strong Should An Airplane Be?*

A. What terms are used to describe the strength of a plane?
Design load; gross weight; useful load; pay load; ultimate load factor, yield load factor, safe operating load factor.

B. How are the load factors determined when the plane is built?
Engineering calculation; static testing; flight testing, accelerometers.

C. What considerations govern the choice of strength for a plane?
Use, civil or military; cost; weight; range of operating maneuvers.

D. In what form are loads imposed upon the structure of a plane by the four forces?
Stresses—tension, compression, bending, shear, and torsion; action of stresses upon characteristic parts—tension upon vertical braces, compression upon landing-gear struts; bending upon the wing spar; shear upon landing gear bolts; and torsion upon the crankshaft.

E. What flight maneuvers impose the greatest loads upon the structure of an airplane?
Load factors in steep banks and increase in stalling speed; load factors in dive pull-outs and maneuvers from which they may result; load factors in gusty air and the necessity for slowing down the airspeed; dangers in exceeding the certificated gross weight of a plane.

Types of Class Demonstrations:

Films

*Static Testing, Airplane Structures,* U. S. Army Signal Corps Training Film 1-312, 16-mm. sound, 12 min. $1.00 Rent from Castle Films.

*Airplane Structures: Structural Units, Materials, and Loads for Which Designated,* TF 1-211, 16-mm. sound, 8 min. $1.00. Rent from Castle Films.

Film Strip

*Rigging Changes after Flight Check*, No. 419. Purchase from Castle Films, 65c.

Types of Student Activities:

Prepare and perform simple experiments to demonstrate the action of the stresses. Consult a physics text.

Report on physical sensations indicative of increased loads in steep turns, in stalls, and in spins if such flight has been experienced; explain the physical and biological reasons for the sensations.

Airport Laboratory Plan:

LESSON 6: *Demonstration of Operations Limitations for the Structural Safety of Airplanes, Forty Minutes of Flight Experience Included.* (See page 179.)

PROBLEM II. *How Are Conventional Aircraft Constructed?*

A. What factors govern the choice of materials and type of construction for each part?

Strength, lightness, rigidity, streamlining, shock absorption; cost, and ease of repair and maintenance.

B. In what materials do we find the most desirable characteristics for the construction of airplanes?

Woods; aluminum, steel, magnesium, and copper alloys; plastics; fabrics; rubber, asbestos, and other miscellaneous materials.

C. How is the wing built?

Types and attachment to the fuselage; parts, their materials and construction—spars or beams, ribs, internal and external bracing, reinforced leading edge, capstrips, fittings, fabric, plywood, and stressed skin covering, plastic construction, ailerons, flaps.

D. How is the fuselage constructed?

Types—truss, welded steel tubing, monocoque, and semimonocoque; parts, their materials and construction—longerons, struts, diagonal members, other internal bracing, bulkheads, formers, and stringers.

E. How is the powerplant attached to the plane?

Engine mount, nacelle, fire wall, propeller attachment to the crankshaft.

F. How is the empennage built?

Vertical fin and rudder, horizontal stabilizer and elevator, tabs—their materials, construction, and operating mechanisms.

G. How are different types of alighting gear built?

Basic requirements—propeller clearance, strength, shock absorption, adaptation to alighting surface; types and construction—fixed and retractable, conventional, tricycle, floats, pontoons, skis, hull, wheels; shock absorbers—rubber cord, rubber disc, oleo.

H. How are materials and parts of an airplane safetied?

Joining—glue, screws, bolts, nails, soldering, brazing, welding, riveting seaming; fastening—bolts and nuts, machine screws, clevis pins, taper pins, lacing, lock wire, cotter keys, elastic stop nuts, and other kinds.

I. What safety precautions are taken in the construction, maintenance, and care of airplanes?

Manufactured only under type or production certificates; flown under registration and airworthiness certificates; required inspections, line check, periodic inspection or 100-hour check, inspection after repair and before re-licensing; repaired only by certificated mechanics, (note move to permit owner to make more of the repairs on non-commercially operated planes); records kept in aircraft and engine log-books.

J. What are some of the problems confronting aircraft design and construction in the future?

Peacetime adjustments will require a change over from performance at any cost, to perform at a profitable cost to the consumer; many newer and more unconventional types of aircraft such as the flying wing, the jet or exhaust propelled plane, and the like, need much development before their real possibilities are made practical; wartime expansion, with its postwar problems of reconversion and excess stock piles, is likely to stifle initiative in design and production for some years to come unless a healthy competition develops in peacetime air commerce and transportation.

Types of Class Demonstrations:

Films

*The Construction of a Light Airplane,* 16-mm. sound, 22 min. Pennsylvania State College Extension Service, Audio-Visual Aid Department. $1.25.

*Airplane Structures: Wing Construction,* TF 1-212, 11 min.
*Airplane Structures: Fuselage Construction,* TF 1-213, 8 min.
*Airplane Structures: Alighting Gear,* TF 1-215, 10 min.
*Airplane Structures: Control Surfaces,* TF 1-700, 7 min.
*Airplane Structures: Manufacturing Methods,* TF 1-323, 25 min.
Each $1.00, except TF 1-323—$2.00. Castle Films.

Film Strips

*Introduction to Airplane Structures,* No. 351, 35-mm.
*Structural Units,* No. 352, 35-mm.
Each 65c. Purchase from Castle Films.

*Check and Double Check,* 35-mm. $3.50. Purchase from Jam Handy.

Types of Student Activities:

Prepare models to illustrate construction of parts of a plane. Develop a series to show historical changes.

Collect materials to demonstrate safetying in fastening aircraft parts.
Prepare class demonstration of operation of oleo strut, rubber cord, and rubber disc types of shock absorbers.
Construct a device, full size if feasible, to show the proper rigging and operation of the control assembly.

UNIT IV

PROBLEM I. *What Is the Importance of Power to Flight?*

A. Why do we date aviation from the Wright Brothers?
Need for choice of direction, altitude, and range if flight is to be "practical"; self-contained power only means of achieving choice; dependence of balloons and gliders upon whims of air ocean; problem of weight delaying earlier application of power to flight; the Wright Brothers' successful internal combustion engine.

B. How potent a force has power been in shaping the past ten years of history?
Dominance in military air power determined by planes whose engines carried them highest, swiftest, and most safely; global conception of society and politics developed by air travel in planes whose engines carried them over increasingly dangerous, but increasingly direct routes to far corners of the world.

C. What recent developments prove the continuing importance of power as a dominant factor in flight?
Military air innovations derived largely from new methods of power production and improvements upon old methods—jet and exhaust propelled planes, rocket planes and bombs, 3400 HP engines for long-range bombers.

D. What requirements must satisfactory powerplants meet?
Low weight per horsepower; flexibility of operation; economy of fuel consumption; inherent balance; reliability; low cost of maintenance.

E. How does our most satisfactory powerplant, the internal combustion gasoline engine and its accessory apparatus, work to produce power?
The four-stroke cycle engine *versus* the two-stroke cycle engine; intake, compression, power, and exhaust strokes in the Otto cycle.

F. How is the performance of an engine measured?
Calculations on horsepower; indicated, frictional, and brake horsepower; mechanical efficiency.

G. How is energy created and how is it converted to useful work?
Heat energy produced by burning fuel; types of fuels suitable; engine stroke; compression ratio, valve overlap, piston displacement, volumetric efficiency.

H. What part does the propeller play in utilizing the power created in the engine cylinder for flight?

Transmitting the power to the propeller—the crankshaft, frictional and brake horsepower; the propeller pushing or pulling the plane through the air; purpose and construction of various types of propellers—fixed-pitch of laminated metal, wood or plastic, adjustable-pitch—wood or metal blades; controllable-pitch—metal; constant-speed; feathering; propeller reduction gears; pilot controls.

I. What care should be taken of the propeller for safety and greatest efficiency?

Regular inspection for cracks, dents, balance, propeller attachment to the hub, proper attachment of hub to the crankshaft to prevent dangerous vibration; most servicing of more complicated types done at the factory.

Types of Class Demonstrations:

Demonstrate principle of four-stroke cycle engine by a working model.

Films:

*Airplane Propellers: Principles and Types,* TF 1-246, sound, 16-mm. 19 min. $1.50. Rent from Castle Films, Inc.

*Thermodynamics*, 16-mm. sound, 15 min. Rent from Encyclopedia Britannica Films, Inc.

Film Strip

*The Airplane Engine,* $3.50. Purchase from Jam Handy.

PROBLEM II. *What Are the Operating Principles of the Functional Divisions of the Airplane Powerplant and How Are They Constructed and Maintained?*

A. What are the functional divisions of the airplane powerplant?

The engine itself; the fuel system; the lubrication system; the cooling system; the electrical system; instruments; controls; accessories; and propeller.

B. By what method are typical engines classified?

Number and arrangement of cylinders; cooling method; horsepower; manufacturer's name and model name.

C. How is the engine built? What is the purpose of each part?

Cylinders; valves, valve seats, valve springs, valve operating mechanisms; cams, camshaft, cam ring; pistons, connecting rods, articulated connecting rod; crankshaft, crankthrow; bearings, crankcases; the intake manifold, the exhaust manifold.

D. What factors form the fuel system?

Fuel—benzol, ethyl alcohol, gasoline, octane rating of gasoline; fuel tanks and supply lines; the carburetor—pressure and gravity fuel feed, operation of the carburetor, air intake, main-jet operation, the throttle, idling system, priming pump, accelerating system, economizer system, altitude control, float system, fuel strainer, injection-type carburetion, the supercharger.

E. How does the electric system assist the internal combustion?
Ignition system—battery and/or magneto, breaker, distributor, spark plug, and switch dual-ignition systems, booster magnetos; types of starters—hand crank, hand inertia, electric inertia, cartridge type; bonding and shielding; firing order.

F. How does a typical lubricating system operate and what lubricants does it use?
Splash and pressure systems, oil pumps, wet and dry sump types; types of crude petroleums, refining, SAE and Saybolt numbers; starting in cold weather.

G. What are the purposes and operating principles of modern aircraft cooling systems?
Necessity for cooling—heat distribution by exhaust, friction, conduction, radiation; air cooling—method and advantages; liquid cooling-method and advantages.

H. How is the modern airplane motor kept within safe operating limits during flight?
Factors affecting engine operation—altitude, air temperature and moisture, flight attitude; tachometer; temperature and pressure gauges; exhaust-gas analyzer; synchroscope; other instruments; operating principles, reading.

I. How is the airplane motor maintained in good operating condition?
Responsibility of owner; responsibility of mechanic— qualifications for certification; engine log-books; required inspections—line inspection, periodic or 100-hour inspection, engine overhaul including disassembly, cleaning, inspection and replacement, subassembly, final assembly and test.

Types of Class Demonstration:

Secure magneto, carburetor, engine instruments, and other small parts from a nearby airport for class examination and discussion.

Secure manufacturers' charts for class display and study, such as those of engine instruments by Eclipse-Pioneer Division of Bendix Aviation Corporation, Teterboro, New Jersey. (Free)

Demonstrate scientific principles of this unit with simple experiments and devices such as those suggested in the *Science of Pre-Flight Aeronautics,* Aviation Education Research Group, MacMillan, New York, 1943, $1.32.

Films:

*Aircraft Engines: Types, Mechanisms, and Oiling System,* TF 1-135, 16-mm. sound, 36 min.

*Aircraft Engines: Ignition,* TF 1-136, 16-mm. sound, 36 min.

*Aircraft Engines: Carburetion,* TF 1-137, 16-mm. sound, 36 min.

Each $2.00. Rent from Castle Films.

Film Strips

*The Airplane Engine*
*Fuel and Feed*
*Airplane Ignition*
*Engine Instruments*

Each $3.50. Purchase from Jam Handy.

Types of Student Activities:

Collect news and magazine articles on latest developments in airplane engines.

Construct working models and non-working models of engine parts, propellers, and instruments.

Prepare drawings to show construction of engines, propellers, and instruments.

Design an original engine, engine part, propeller, or engine instrument.

Airport Laboratory Plan:

LESSON 7: *Inspection and Demonstration of Structure, Maintenance, and Repair of Airplanes, No Flight Experience Included.* (See page 180.)

UNIT V

PROBLEM I. *Of What Practical Value Is a Knowledge of Meteorology?*

A. What is the relation of meteorology to weather?
Meteorology as a science dealing with conditions of the atmosphere and their causes; climate governed by weather.

B. Why should a knowledge of meteorology be important to all persons?
The atmosphere as an essential part of the domain in which we live; agriculture, transportation, resources, commerce, human health, and human activities dependent upon weather and climate.

C. What historical evidence indicates man's long concern about the atmosphere?
Early religions based on atmospheric phenomena; Aeolus, god of the winds; Jupiter Pluvius, god of the rain; and like examples. (Refer to *The Air We Live In* by George T. Renner and Hubert A. Bauer, MacMillan, 1942, 36c.)

D. With what discoveries did interest in the atmosphere become a scientific study?
Galileo's invention of the thermometer in 1590; Toricelli's invention of the barometer in 1643; Franklin's discoveries concerning lightning and storms in 1740; Ferrel's discovery of the planetary circulation of winds in the atmosphere in 1855; Cleveland Abbe's proposal for a national weather service based on information collected by telegraph in 1880; establishment of United States Weather Bureau and those of other nations.

E. What important progress has been made in the science of meteorology during the past fifteen years?
Extension of the United States Weather Bureau and its transfer from the Department of Agriculture to the Department of Commerce; flights and balloon observations to greater heights to secure meteorological information; invention of radiosonde, first method by which immediate and accurate information about the atmosphere can be obtained to heights beyond 55,000 feet; collection of weather data from far corners of the earth by military necessity; further steps toward standardization of international methods of reporting data, use of metric system.

Types of Class Demonstration:
Develop and extend the historical information given in *The Air We Live In*.

Types of Student Activities:
Collect newspaper and magazine articles concerning late developments in collecting weather data.
Report on folk-lore which has developed in connection with attempts to explain weather phenomena. Refer to *Weather Folk-lore and Local Signs*, Superintendent of Documents, Washington, D. C., 1903.
Take photographs of clouds to develop a personal series of cloud types.

PROBLEM II. *How is Weather Information Secured and Made Available to the Public?*

A. What are the meteorological elements measured?
Characteristics of the atmosphere—composition, height, topography; elements determined by visual observation—types of clouds, sky, condition, visibility, state of the weather; elements determined by instrumental measurement—temperature, pressure, humidity, ceiling, wind direction and velocity, amount of precipitation.

B. What are the operating principles of the instruments used to measure meteorologic elements and in what terms are they read?
Thermometers—mercury, alcohol, maximum and minimum, wet and dry bulb, psychrometer, sunshine, hygrometers; barometers—mercury and aneroid; anemometers and wind vanes; ceiling balloons, pilot balloon observations and the odolite; nephoscope; ceiling light and clinometer.

C. How is widespread data gathered for forecasting and how are forecasts and weather details made available to the public?
Use of telephone, radio, telegraph, teletype circuits; standard broadcasts and special broadcasts to and from planes in flight and ships at sea; teletype sequences and daily synoptic weather maps; special devices for storm warnings and flood warnings; contributions of the U. S.

Weather Bureau, the CAA, commercial airlines, ships at sea, the military forces.

Types of Class Demonstration:

Demonstrations of weather instruments. Most needed instruments are standard equipment in school science laboratories.

Set up a school weather station for daily collection of information.

Establish landmark distances to determine local visibility.

Film

*Weather Forecast,* Gaumont British Instructional Films, 16-mm. sound, 25 min. Rent from the Museum of Modern Art.

Film Strip

*The Air Ocean,* $3.50. Purchase from Jam Handy.

Types of Student Activities:

Construct an instrument shelter for the class weather station.

Construct instruments such as an anemometer, a rain gauge, a wind vane for the station.

Airport Laboratory Plan:

LESSON 8: *Weather in Aviation, No Flight Experience Included.* (See pages 180-81.)

PROBLEM III. *How Is Weather Data Interpreted?*

A. Who interprets weather information?
The regional forecaster for the U. S. Weather Bureau; the local representative of the U. S. Weather Bureau; the military meteorologist or aerologist; the airline meteorologist; the airline dispatcher; the CAA Airways Traffic Control; the airport tower operator; the airport manager, and the chief pilot; the pilot on the ground and in the air; the average person.

B. Why is the sun considered the prime cause of all weather phenomena?
Heat—radiation, conduction, convection; heat and pressure—density; heat and moisture in the atmosphere—clouds; precipitation; pressure and winds; Boyle's Law, Charles' Law, Gay-Lussac's Law; conservation of energy, thermodynamics, molecular theory; air masses.

C. How does the stability or instability of the atmosphere affect weather?
Stable, neutral, and unstable equilibrium; adiabatic change and lapse rates; latent heat; thunderstorms and lightning.

D. How do temperature differences determine winds?
General circulation principle of the atmosphere; Ferrel's Law and planetary circulation; land and sea breezes, monsoons; mountain and valley winds; up-drafts and down-drafts; mechanical and thermal convection; inversions, stratosphere.

E. How important are air masses in forecasting?
Sources, history, and classification of air masses; characteristics by type

and season; highs and lows; fronts; air mass analysis; frontal analysis; atmospheric wave theory.

F. What are the most dangerous weather conditions for flight and how can they be avoided or their dangers reduced?
Icing—carburetor icing, propeller icing, wing icing; fog formation; turbulence; effects of weather upon airplane instruments—altimeter, airspeed indicator, rate-of-climb indicator, magnetic compass, and gyroscope instruments; visibility.

G. To what extent should the average person, pilot and non-pilot, be able to interpret the weather?
Visually—meaning of clouds and cloud systems, wind velocity and direction, wind shifts, types of lightning, identification of tornado, possible icing, possible visibility restrictions, approach of storms and their paths and probable violence; reading common weather instruments—falling and rising of thermometer and barometer, wind vane, and the like; reading the teletype sequence, the daily synoptic weather map, winds aloft map—probable change and movement of weather of a relatively small area and a relatively short period of time; consultation with an experienced meteorologist; reading regional forecasts.

Types of Class Demonstration:

Display chronological series of daily synoptic weather maps for interpretation and study of weather movements and change.

Secure teletype sequences when available and supervise class drawing of a synoptic map. Simulate sequences for the purpose.

Films

*Modern Weather Theory; Primary Circulation,* TF 1-133, 16-mm. sound, 19 min. $1.50. Rent from Castle Films.

*Aerology; Ice Formation on Aircraft,* MN-119A, 16-mm. sound, 47 min. Rent from Castle Films.

*Aerology; Thunderstorms,* MN-119, 16-mm. sound, 39 min. Rent from Castle Films.

Film Strips

*Air Masses*

*Weather*

Each $3.50. Purchase from Jam Handy.

Types of Student Activities:

Prepare daily station models from information gathered in the class weather bureau.

Report on pilot experiences with weather such as those given in *Lessons that Live,* as told by AAF Pilots, a pamphlet published for the USAAF.

Report on how a pilot can anticipate and recognize fog, ice formation on aircraft, and thunderstorms and how he should fly with regard to

them. Refer to *Fog, Ice Formation on Aircraft,* and *Thunderstorms,* Aerology Series, Training Division, Bureau of Aeronautics, U. S. Navy.

Airport Laboratory Plan:

LESSON 9: *Weather in Aviation, Twenty Minutes of Flight Experience Included.* (See pages 182-83.)

PROBLEM IV. *What Part Has Meteorology Played in Daily Life This Past Year?*

A. What effect has previous weather knowledge had upon military campaigns in Europe, Africa, the Aleutians, and the Pacific?
Landing days in Italy, France, and Holland; The choice of D-Day; Burma, India, and the monsoon season; the African campaign; fog in the Aleutians; island landings in the Pacific.

B. How has meteorology helped anticipate and prevent disasters in our own country?
Flood control; the fruit crops and frost forecasts; the September hurricane warnings.

C. How has meteorological information affected your personal life?
The winter coal delivery; the choice of clothes for school; the arrival of travelling friends; the change in the strategy for the football game; choice in a time for vacation.

Types of Class Demonstrations:

Display a large map of the world for students to attach clippings of items of world information concerning weather.

Types of Student Activities:

Collect articles proving meteorology's importance to everyday life.

UNIT VI

PROBLEM I. *What Is Navigation and What Factors Does It Involve?*

A. What is navigation?
Definition—directing oneself from here to there; common uses—choosing a route to school and to work, finding a friend's home, avoiding a detour, driving to an unfamiliar city, planning a trip by rail, by ship, or by air; lines of position or co-ordinates, grid systems in city streets and on military maps.

B. What is the relative importance of each of the four types of air navigation?
Types—pilotage, dead reckoning, radio navigation, celestial navigation; advantages and disadvantages of each type; relative use and limitations of each type.

C. What are the special problems involved in locating positions upon a sphere?
Difficulty of finding reference points; true or geographic poles; meridians and parallels—equator, prime meridian, and international date line; latitude and longitude; problems of time, distance, and direction.

D. How is time reckoned?
Year, month, day, and night; earth's path in its orbit and revolution upon its axis; inclination of earth's axis to plane of its orbit, seasons; arc time—degrees, minutes, seconds of longitude; true solar time, mean solar time—hours, minutes, seconds; zone time—standard, daylight saving, and war time; the chronometer.

E. How is distance measured?
Degrees, minutes, seconds of arc; statute and nautical miles; great circles and small circles; relation between measurement of latitude and of longitude in degrees, minutes, and seconds of arc and in terms of actual distance.

F. How is direction determined?
True North as a reference point; measurement of angles of direction —use of protractors, necessity for meridians which are straight lines; directions of rhumb line and great-circle routes—courses, bearings, and azimuths; the compass rose—use of parallel rulers.

G. How do lines of magnetic force affect direction-finding?
Magnetic poles; true, magnetic, and compass directions; variation and deviation errors—correcting and compensating; magnetic charts—agonic and isogonic lines; swinging the ship, the deviation card.

H. What are the principal navigation instruments other than the compass and the radio instruments, and how are they used?
The clock; the sensitive altimeter-lag, pressure altitude, altimeter setting, Kollsman number, correction for temperature and pressure errors; the air-speed indicator—correction for temperature and altitude errors; the rate-of-climb indicator; the drift sight; the directional gyro; the turn indicator; the bank indicator; the artificial horizon.

Types of Class Demonstration:

Film

*The Airplane Changes the World Map,* 16-mm. sound. Rent from Encyclopedia Britannica Films, Inc.

Film Strips

*The Earth, Latitude and Longitude,* 35-mm. $3.50. Purchase from Jam Handy.

*Flight Instruments,* 35-mm. $3.50. Purchase from Jam Handy.

Demonstrate problems of map-making by use of a globe of the earth. Demonstrate principle of the magnetic compass by floating magnetized needle on water. Show deviation exerted by presence of steel and iron. Secure and display wall charts of instruments. (Write to Eclipse-Pioneer Division of Bendix Aviation Corporation, Teterboro, New Jersey. Free)

Types of Student Activities:

Cut a circle of cardboard to fit closely the globe used in the classroom.

Calibrate it in 360 degrees and use it to measure distance between important cities on earth's surface in terms of arc and of nautical miles.

Prepare three concentric compass roses of cardboard, one with its North to represent the true North Pole, one with its North to represent the magnetic North Pole, and the other with its North to represent the North of a compass. Use to demonstrate "variation" and "deviation" errors and their correction.

If possible, borrow a magnetic compass of the type used in planes and its deviation card to demonstrate to the class.

PROBLEM II. *How Accurately Do Maps Represent the Earth's Surface?*

A. What properties are desirable in map-making?

General properties—true shape of physical features, correct relative proportions for areas, true scale values for distances, correct angular measurement; other properties of special importance to navigation—representation of great-circle routes and of rhumb-line routes as straight lines, representation of meridians as straight lines to permit measurement of direction angles; necessity for compromise among desirable features.

B. By what methods is the earth's rounded surface shown upon flat maps?

Types and methods of map projection—mercator, gnomonic, polyconic, Lambert conformal conic, other types; characteristic appearance of meridians and parallels on maps made by the different projections; special properties and uses of maps made by mercator, gnomonic, polyconic, and Lambert conformal conic projections.

C. What special maps are available for air navigation?

Charts issued by the U. S. Coast and Geodetic Survey—aeronautical planning, great circle, magnetic, radio direction-finding, regional, sectional, special areas; special uses and limitations of each type; charts issued by U. S. Hydrographic Office for ocean areas.

Types of Class Demonstration:

Film

*Maps and Map Reading,* T. F. 16-mm. sound, 30 min. Rent from Castle Films.

1. Display maps made by different types of projections such as those issued by the *National Geographic Magazine.*
2. Secure copies of *Maps and How to Understand Them* by Consolidated Vultee Aircraft Corporation, P. O. Box 157, New York, N. Y. if still available. Free.
3. Secure and display aeronautical charts of the United States. Sectional and regional maps may often be secured at local airports or borrowed from pilots. Some restrictions still exist as to purchase, but inquiry can be made to the U. S. Coast and Geodetic Survey, Washington, D. C.

Types of Student Activities:

Collect for class display, maps made by different types of projections.

PROBLEM III. *What Are the Problems Involved in Piloting or Landmark Flying?*

A. Why is the term "contact flying" sometimes used for "piloting"?
Landmark flying possible only during fair weather; weather classifications "C", "N", and "X"; review of contact-flight weather minimums.

B. What maps are best suited to piloting or landmark flying, and how is topographic and aeronautical information given on them?
Sectional and regional maps; topographic information—water features, cultural features, relief; aeronautical data—airports, light beacons, radio aids—radio range, radio-marker beacons and fan-marker beacons, radio stations, airways, special areas, prominent obstructions; sources of information concerning recent changes.

C. What preparation should a pilot flying "contact" make before flight to insure his safe arrival at his intended destination?
Securing required current sectional maps and regional maps; determining the route and possible alternates after considering hazardous terrain, nature and location of landmarks, fuel range of plane, possible emergency landing areas; marking distance intervals along route, marking time intervals along route; folding map; checking weather; checking fuel supply and condition of the plane; estimating time of arrival at destination; optional filing of flight plan with Airways Traffic Control.

D. What practices during flight help prevent becoming lost?
Flying high enough to have sufficient view of landmarks and their relationships; flying or steering a range; flying to one side of landmarks; estimating ground speed and time of arrival over next landmark; checking fuel supply, flight time, and hours of daylight.

E. What procedure should be followed when lost while "piloting" a plane?
Check on fuel supply for estimate of flight time remaining: spiral to gain altitude while thorough attempt at orientation by checking landmarks over same spot is made; choose and fly a definite heading (use compass if possible) to an assumed landmark given on the map, for a reasonable length of time (noted on watch, not estimated); avoid low flying and frequent changing of direction; if expected landmark does not appear, repeat process until 30 minutes of fuel time remains or until approach of sundown; if still lost, choose and drag suitable site for forced landing; land, arrange guard for plane, and phone base. (Refer to U. S. Navy Flight Training Manual No. I, CAA W. T. S. Elementary, Civil Aeronautics Administration, Washington, D. C.)

Types of Class Demonstrations:

Film

*Airways Flying,* T.F. 1—328, 16-mm. sound, 38 min. $2.00. Also rent from Castle Films.

Film Strips

*Air Pilotage*

*Airway Aids*

Both 35-mm. $3.50. Purchase from Jam Handy.

Assign suggested flights from the local airport to class members so that they may study the local sectional map to determine the route to fly. Have students prepare lists of prominent landmarks along their routes, giving distance intervals and time intervals for different ground speeds.

Types of Student Activities:

Report upon *Air Markers and Illumination of Airways* Flight Series No. 36. American Technical Society, Chicago, Illinois, 1941.

Report on actual incidents which illustrate good and bad practice in landmark flying. These may be from reading or from conversations with pilots.

PROBLEM IV. *How Is Dead Reckoning Used In Navigating a Plane?*

A. Why is "dead reckoning" the principal method used for air navigation other than "piloting"?
Definition; basic use in radio and celestial navigation; principal problems before flight and during flight.

B. What procedure is used to determine the compass heading to fly in order to hold a desired route to a destination?
Before flight—measuring the true course, correction for converging meridians on Lambert charts, correcting for wind to determine the true heading, airspeed, ground speed, wind-drift angle and wind-correction angle, correcting for variation to determine the magnetic heading, correcting for deviation to determine the compass heading to fly; during flight—steering a range between two landmarks known to be "on course" to determine compass heading to fly.

C. What procedure is used to determine position during flight?
Rectifying the compass heading to determine the magnetic heading, rectifying the magnetic heading for variation to determine the true heading, rectifying the true heading for wind to determine the true course or "track"; plotting the true course on the map; estimating position from track, ground speed, and elapsed time.

D. How are some of the special problems of dead reckoning solved?
Off-course problems; simple radius of action and alternate airport problems; determining wind by "double drift"; reference to other types of problems.

E. What practical methods are used for rapid computation of navigation problems?
Reference to use of tables and graphs; practice in use of simple computers in general use.

Types of Class Demonstrations:
Assign flight problems from the local airport. Have a student secure the proper weather information for the class. Have class determine compass heading to fly before flight, using the local sectional chart. In the theoretical flight, illustrate an "off-course" problem and a "double-drift" wind problem using computers.

PROBLEM V. *What Are the Principal Practices in Radio Navigation?*

A. Why is radio navigation increasing so rapidly in importance?
One of simplest and easiest methods of position-finding during flight makes available immediate information about weather, traffic, and landing conditions, only type usable in bad weather; increasing traffic makes voice communication imperative at larger airports; decrease in cost of radio equipment encouraging installation in smallest planes; auxiliary use of "landmark" flying giving added safety factor; improvements in radio aids and use of radar promising for future navigation; contrast with limited practical use of celestial navigation.

B. What special equipment and training must a pilot have to navigate by radio?
Supplementary use of receiver only in piloting; licensing the radio transmitter, securing a restricted radio telephone operator's license to operate it; the flight plan and Airways Traffic Control; instrument flight—minimum required instruments, other special radio equipment such as radio compass, automatic direction finder, automatic pilot, and radio altimeter; pilot requirements for "instrument flight rating."

C. What use can a pilot make of radio aids to navigation?
Auxiliary use with landmark and simple dead-reckoning navigation; following the radio range—orientation, beam-bracketing, the radio "fix", the cone of silence, radio-marker beacons, fan-marker beacons, special errors of radio; securing and plotting radio bearings to determine a "fix," review of instrument traffic and weather regulations; position-finding for planes in flight by ATC.

Types of Class Demonstrations:

Film

*Aerial Navigation. Radio Aids.* 16-mm. sound, 30 min. $2.00. Rent from Castle Films.

Film Strips

*Radio and Control*
*Celestial Navigation*
Both 35-mm. $3.50. Purchase from Jam Handy.

If feasible, secure a radio receiver for frequencies used by aircraft in flight by towers and by radio ranges. Have class members listen to range signals and conversation of pilots and traffic personnel.

Types of Student Activities:

Report to class on next date and nearest place of an examination by the Federal Communications Commission for restricted radio telephone operator's license. Write for application blank and report on requirements.

Select a route for a flight from a local airport of approximately 90 minutes in a light airplane. Prepare a list of prominent landmarks along the route, determine the true course to fly, determine the radio aids available along the route, review procedures and responsibilities in filing a flight plan, and review traffic rules and procedures likely to be needed on such a flight.

Airport Laboratory Plan:

LESSON 10: *Cross-Country Flying under the Direction of the Class Teacher and the Flight Instructor, Ninety Minutes of Flight Experience Included.* (See pages 183-85.)

UNIT VII

PROBLEM I. *What Important Problems Concerning Aviation Confront the Postwar Period?*

A. What will happen to surplus military materials and trained personnel when the war is over?

Return of military personnel to civilian life; needs for larger permanent air force; retraining the military pilot for civilian flying.

B. What were some of the mistakes that followed World War I?

Disintegration of U. S. Air Force—(peak strength of 195,000 shrunk to 35,000 by 1938); reasons for dissolution of French Air Force which was rated the finest in the world; disposition of military material after World War I; comparison of pre-war peacetime aviation training here and in Germany, Italy, Russia, and Japan.

C. In the interest of national security, what types of programs are needed to preserve the aeronautical skills of military persons trained in this war, and to prepare a continuing flow of possible replacements?

General education of the public as necessary basis for securing the stimulation and approval needed by any program; air corps reserve training to preserve skills (note plan in operation after World War I); general aviation education in the public schools, more specific aviation education in the secondary schools as an important factor in success of programs on higher levels; suggested plan for voluntary ROTC of the Air Corps for colleges.

D. For what additional reasons should aviation courses be offered in the public schools?

Peacetime demands of personal flying—3000 civilian student permits issued monthly by CAA in past year, both private and commercial pilot licenses now obtainable by boys and girls of high-school age; success of programs for both political and economic security based upon an informed public. (Service is needed and if not provided by the public schools, likely to be provided by some other competing agency.)

E. As an economic and political safeguard, what part must our country take in the expansion of air trade routes?
Postwar trade and competition; need for international agreement upon rules of air navigation, standards of airworthiness, organization of air routes; easy conversion of peacetime air routes for surprise military attacks (note German control of small South and Central American lines at outset of World War II).

F. Does this district need an airport?
Status of present airport service and probable needs for future service; other bases for airport planning, suitable locations, sufficient means for financing adequate development; types of airports—major air terminals, general airports for commercial operation and flight training, manufacturers' airports, auxiliary fields, airstrips, aviation club airports; community benefits from airports—attraction of new industries, increase of local trade and business, servicing and developing private aviation.

Types of Class Demonstration:

Arrange forum discussions on postwar aviation problems. Secure the co-operation of aviation agencies and interests in presenting the forum to assembly programs for students, for Parent-Teacher Associations, and for other civic organizations.

Direct the class in a survey of the district's airport facilities and needs —existing airports, their services and convenience to centers of population, numbers of licensed pilots in the area, number of student permits issued for the district during past year and other information related to the survey.

Direct the class in preparing maps of pre-war world aviation routes to show comparisons of interests and developments by the various nations. Prepare a modern map to show routes of United States in operation now and ones for which requests for permission have been filed with the CAB.

Types of Student Activities:

Report on *Keep the Peace through Airpower* by Allan A. Michie, Henry Holt and Company, New York, 1944, or other pertinent books. Secure and present to the class information on Federal airport planning. Write to the Airport Planning Division of the Civil Aeronautics

Administration, Department of Commerce Building, Washington, D. C.

Secure and present to the class information on state and local airport plans for your district. Write to the Pennsylvania Aeronautics Commission, New Cumberland Airport, Harrisburg, Pa.

## Airport Laboratory Plan

### Lesson 1

**Familiarization Tour of Local Airport[6] with Ground Instruction by Class Teacher and Airport Personnel. No Flight Experience Included:** (See page[7] 151.)

*Ground Instruction[8] by Class Teacher*

Point out physical plan of airport, use and location of administration building, hangars, apron, flight line, fueling facilities, wind sock or tee, runway and boundary lights and markers, and airport lights and markers, if any. Call attention to types of planes flying and on the ground, to observance of traffic rules.

Point out certificates licensing the airport and any flight and mechanic schools and repair station at the field. Note types of service given.

*Ground Instruction by Personnel of Control Airports*

Discuss briefly, demonstrate, or call attention to current demonstration of the services, equipment, and operation of the Airport Control Tower, the Airways Traffic Control Center, the Weather Bureau, and Airline Reservations and Operations.

*Ground Instruction by Chief Pilot or Manager of Airports Which Are Not Control Airports*

Discuss and point out on map local flight patterns, flight and practice areas, and restricted areas. Explain and give practical demonstration of local procedure for securing flight permission, for securing maps and weather information, for determining the official hours of sunrise and sunset, and for filing flight plans.

Discuss and, where possible, call attention to current demonstrations of observance of local and general traffic rules in taxiing, in takeoffs and landings, and in the air.

During the tour of the hangars, point out types of planes and their uses; discuss original and operating costs of different types, give a cross-section

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[6] It is understood that the information in this lesson will be presented by the personnel of control airports in their explanations and demonstrations.

[7] This page reference refers to Lesson One as found on page 151 in the *Course of Study* above. This Airport Laboratory Plan has been printed so that it may be kept as a complete unit, or used as an integral part of the *Course of Study*. For example, pages 174-75 of his reference indicates that it follows Lesson 1 on page 151 of the course of study. Each lesson topic of this *Plan* is followed by a page number which similarly refers to the *Course of Study* above.

[8] If the class has access only to a small airport and such an arrangement seems more satisfactory, Lessons 1 and 2 might be given on the same day.

of the ownership of the private planes, show registration and airworthiness certificates, pilot and mechanic certificates, pilot, aircraft, and engine logbooks. Explain procedures and costs in flight instruction. Detailed explanation and attention to the parts and operation of the planes should be left for Lesson 2.

LESSON 2

**Tour of the Hangars and Inspection of Aircraft for Identification of Parts and General Construction. Ground Instruction by the Class Teacher, Chief Mechanic, or Other Qualified Representative of the Airport. No Flight Experience Included:** (See page 153.)

*Ground Instruction by Class Teacher, Chief Mechanic, or Other Qualified Airport Representative*

Point out main parts in the construction of planes with special attention to wing shape and area, aspect ratio, stabilizers, and trimming tabs. Call attention to controls and control surfaces, slots, flaps and their operation, streamlining by means of general construction, engine ring and cowling, wheel pants, fairing, and other factors.

If there are any biplanes, show stagger.

Show how fabric covering is fastened and doped for tautness in order to eliminate skin friction. Point out method of eliminating skin friction on stressed skin coverings.

Call attention to parts of the propeller and its attachment to the crankshaft. Discuss and illustrate, if possible, propellers of different pitches, calling attention to the airscrew and airfoil characteristics of each.

Run a line inspection and let each student check items as they are completed, on his own copy of the CAA line inspection form. Point out that before each flight-experience lesson, each student must make an individual line inspection on the plane he will fly under the supervision of a mechanic or certificated pilot of private grade or better.

LESSON 3

**Familiarize with the Airplane on the Ground and in the Air under the Direction of the Flight Instructor. Thirty Minutes of Flight Experience Included:** (See page 154.)

*Ground Instruction by the Flight Instructor Prior to Flight*

Recall local procedures for flight permission, local and general traffic rules on the ground and in the air needed for the flight. Indicate personal possession of proper pilot certificate with instructor's rating, registration and airworthiness certificates of plane, and dual controls in plane.

Demonstrate how to move the plane and to secure help for the purpose, where to place the plane, and how to block it and set the parking brakes. Assist student in making a line inspection[9] and checking fuel supply. Point

[9] For succeeding lessons in flight experience, student will make line inspection under direction of a mechanic or other qualified person. He will present to the flight instructor prior to flight, a signed line inspection form to that effect.

out danger in relying on gauges and demonstrate safety precautions in refueling.

Recall that regulations call for a competent operator at the controls of running engines at all times, and remind student always to have mechanic or other qualified person to assist him in starting if there is no self-starter.

Have student get into plane and fasten safety belt. Point out importance of keeping it fastened on the ground as well as in the air.

Let student move the controls freely to note lack of air resistance and consequent lack of effect. Discuss functions of controls in flight. Point out relative effectiveness of controls in taxiing and in the air and the reasons. Discuss taxiing upwind, downwind, crosswind.

Direct student in correct procedures for starting the engine and checking instruments for its proper operating condition.

Assist student to determine wind direction, proper runway to use, safe taxi path, and takeoff clearance.

Demonstrate use of throttle and brakes in taxiing, procedure in takeoff, and direct student in taxiing.

If parachute is to be worn, show how to determine the date of its last packing and recall limitations. Assist student to adjust parachute on himself and explain its use in emergencies.

*Flight Experience under Direction of Flight Instructor*

Demonstrate takeoff, and, at a safe altitude, demonstrate functions of the controls, separately and in co-ordination, medium and gentle turns, skidding and slipping in turns.

Direct student in free use of the controls, in medium and gentle turns, and straight and level flight.

Demonstrate flying in traffic, and traffic and flight procedures for landing.

*Ground Review Immediately after Flight under Direction of Flight Instructor*

By questioning student and answering his questions, recall importance of pressure exerted rather than amount of travel in determining effects of controls, procedure in determining whether flight is straight and level, and necessity for co-ordination of controls.

Demonstrate care of the plane after flight.

Check and sign student's log.

LESSON 4

**Demonstration of Stability in Airplanes under the Direction of the Flight Instructor, Thirty Minutes of Flight Experience Included:** (See page 155.)

*Ground Instruction by the Flight Instructor Prior to Flight*

Check to see that student has made line inspection under proper supervision.

Assist him in checking on the fuel supply.

With the aid of a mechanic or other qualified person give student demonstration and practice in proper way to turn propeller for starting the engine.
Point out features in the construction and rigging of the plane which contribute to its stability in flight.
Discuss the purpose and operation of the horizontal stabilizer and trimming tabs, if any. Explain that a commercially airworthy airplane, if properly trimmed, should practically fly itself.
Recall the dangers in overloading or incorrectly loading a plane. Point out loading specifications in plane used, including baggage restrictions and restrictions on seat used by pilot for solo flight.
Discuss torque effects.
Supervise student's traffic procedure and handling of the plane in taxiing to takeoff.

*Flight Experience under Direction of Flight Instructor*

Point out use of rudder to correct torque effect during takeoff run.
Supervise student in straight and level flight and medium turns, and coordination exercises.
Demonstrate safety precautions for traffic in the air by looking around carefully before turning and by clearing the ship with a 90-degree turn in opposite directions before changing altitude.
Demonstrate and direct student in climbs and glides, use of the throttle in climbs and glides, trimming the ship for straight and level flight and for climbs and glides, climbing turns, gliding turns.
Demonstrate stability in banking, pitching, and yawing by confidence maneuvers, and direct student in their performance.
Demonstrate gliding turns for landing and 1000-foot straight approach.

*Ground Review Immediately after Flight under Direction of Flight Instructor*

By questioning student and answering his questions, recall behavior of plane in confidence maneuvers and reasons, torque effect on takeoff, uses of climbing turns and gliding turns. Point out that all maneuvers are combinations of the four fundamental maneuvers—straight and level flight, the climb, the glide, and the turn.
Point out that some planes, especially military planes, sacrifice stability for maneuverability.
Recall the necessity for clearing ship before engaging in any maneuver other than straight and level flight.
Check and sign student's log.

LESSON 5

**Demonstration of Variation of Lift under the Direction of the Flight Instructor, Thirty Minutes of Flight Experience Included:** (See page 156.)

*Ground Instruction by Flight Instructor Prior to Flight*

Check to see that student has made line inspection under proper supervision and that fuel supply is adequate.

Discuss means of obtaining lift. Point out shape of airfoils. Explain purpose and reading of tachometer and airspeed indicator and their indication of operating limitations of the plane used. Remind student of distinction between airspeed and ground speed, the meaning of angle of attack, stalling angle, stalling airspeed, loss of effectiveness by controls during approach to a stall, what a stall is and how recovery can be effected, that a landing is an approach to a stall near the ground.

Explain what is meant by "crabbing" to overcome drift.

Remind student of danger in mistaking ground speed for airspeed when flying near the ground.

Point out that parachutes must be worn during stalls and spins. If student has not worn one previously, assist him to adjust it now and explain its use in emergencies.

*Flight Experience under the Direction of the Flight Instructor*

Demonstrate proper method of securing greatest lift safely on takeoff.

Point out changes in airspeed, rpm of motor and sound of motor with changes of angle of attack in climbs and glides, climbing turns, and gliding turns.

Direct student in performance of maximum climbs, minimum glides, climbing turns, and gliding turns.

Demonstrate approaches to stalls, calling student's attention to ineffectiveness of controls and falling airspeed.

Demonstrate elementary power-on and power-off stalls and recovery from them. If advisable, permit student to perform them.

Demonstrate "crabbing" in rectangular patterns, "S" turns across roads, or other maneuvers at a low altitude. Supervise student in their performance.

Demonstrate 180-degree approach, an approach to stall on landing.

*Ground Review Immediately after Flight under Direction of Flight Instructor*

By questioning student and answering his questions, have him recall his personal sensations, the variation in sounds, the feel of the ship and of the controls at the approach, during the stalls, and during recovery from stalls.

Remind student that airspeed indicators are not always accurate, so it is not safe practice to expect a plane always to stall at the same indicated airspeed.

Point out that other types of planes, especially heavier and less stable ones, break more quickly at the stalling angle, that the pilot has a much shorter time to recognize the approach of a stall, and that the controls must be more carefully manipulated during recovery.

Discuss experienced pilots' practice of taking an unfamiliar ship to a safe altitude to learn its stalling characteristics in order that they may know proper procedures in landing where the plane must be operated close to its stalling speed.

Check and sign student's log.

LESSON 6

**Demonstration of Operations Limitations for the Structural Safety of Airplanes under Direction of Flight Instructor, Forty Minutes of Flight Experience Included:** (See page 157.)

*Ground Instruction by the Flight Instructor Prior to Flight*

Check to see that student has made line inspection under proper supervision. Check student's parachute.

Remind student of significance of airspeed *versus* ground speed.

Recall meaning of loads on aircraft. Point out safe operating load factor for plane used, effects of use and poor maintenance.

Discuss loads imposed by different maneuvers, including bad landings, dangers in sudden pull-outs from steep dives and maneuvers from which they may result, danger in exceeding maximum safe airspeed. Recall increase of stalling speed in banks.

Discuss nature of spins and spin recovery. Point out that the plane used will recover from a stall or spin "hands off" if altitude permits.

Discuss forward and side slips and their safe use to lose altitude quickly without increasing airspeed.

*Flight Experience under Direction of Flight Instructor*

Demonstrate correction for drift on a takeoff.

Demonstrate and direct student in practice of co-ordination exercises to hold a point, climbing turns, gliding turns.

Demonstrate increase of speed needed to provide more lift in steep turns. Call attention to personal effects and feel of controls in steep turns with increase of loads on the plane.

Demonstrate that spin results from a stall. Demonstrate one-turn, and if advisable, two-turn spin and recovery.

Demonstrate approach to accidental spins and, if desirable, actual accidental spins.

Demonstrate 90-degree and 180-degree approach and use of slips for landing. Demonstrate a cross-wind landing and safe recovery from a "bounced" landing.

*Ground Review Immediately after Flight under Direction of Flight Instructor*

By questioning student and answering his questions, help him to recall his physical sensations during steep turns, stall, and spins; discuss reasons. Review stability with respect to stall and spin recovery. Point out that planes which sacrifice stability for maneuverability spin more readily and must be flown out of spins.

Remind student to slow down in bumpy air, "but not to the stalling speed." Point out parts of plane which have had greatest loads imposed on them during the maneuvers performed. Point out necessity for airworthy condition of plane and for its operation within its specified limitations.

Check and sign student's log.

LESSON 7

**Inspection and Demonstration of Structure, Maintenance, and Repair of Airplanes under the Direction of the Class Teacher, the Chief Mechanic, and/or Other Qualified Airport Personnel, No Flight Experience Included:** (See page 162.)

*Ground Instruction by Class Teacher, Chief Mechanic, and/or Other Qualified Airport Personnel*

Supervise inspection of aircraft in the hangars and on the line to illustrate types of fuselage, wing, empennage, and alighting gear construction.

Demonstrate methods of safetying, joining, and fastening.

Demonstrate typical inspection and repair work on planes such as fabric patching, wing covering, rib stitching, reinforcing, doping, riveting, welding, and replacement of tail wheel and shock cords on small planes. Ask students questions to point up procedures used.

Point out parts and discuss operation of 65 HP 4-cylinder opposed or other light engine. Explain reasons for choice of materials in its construction and point out common trouble spots in maintenance.

Point out parts of a larger radial or in-line engine and discuss contrasts with the light engine.

Demonstrate typical inspection and repair work on engines such as magnafluxing, determining wear by micrometer measurement of clearances, replacing oil rings, grinding valves, and the like. Have students take part in the actual work where possible.

Point out installation and operation of a supercharger, if possible.

Call attention to different types of engine lubricating and cooling systems and their problems.

With a student's help, change the pitch on an adjustable pitch propeller. Discuss reasons for variations in pitch, and point out other types of propellers available. Demonstrate care of propeller blades, checking balance, and checking attachment to the hub, if not in one piece, and to the crankshaft.

Demonstrate parachute rigging. (If the airport has facilities for rigging, class might be scheduled on day convenient for the routine packing by the certificated rigger. If not, private arrangements might be made with the rigger to pack at the school where facilities could be arranged.)

LESSON 8

**Weather in Aviation with Ground Instruction by the Class Teacher, a Representative of the Weather Bureau, and/or other Qualified Airport Personnel, No Flight Experience Included:** (See page 164.)

*Ground Instruction by Class Teacher*

Ask students to determine and record individually their visual estimate of the visibility, ceiling, types of clouds, and wind velocity and direction. Check these later with whatever more official means the airport affords.

*Ground Instruction by Representative of the Weather Bureau if Airport has a Weather Station.*[10]

Discuss methods for collecting weather information locally, from other stations, and from planes in flight.

Demonstrate use of visual means and instruments in determining local weather information. If pilot balloon or radiosonde observations are made at the station, time of lesson should be planned to co-incide, where possible.

Demonstrate reading of teletype sequences including winds aloft and regional forecasts. Ask students to read them.

Demonstrate making an interpreting daily synoptic weather maps, including means of determining flight conditions to selected airports. Discuss and show other types of weather maps.

Discuss means of disseminating weather information to pilots before flight and in the air by means of personal conferences and use of maps and teletype, by telephone, and by radio telephone. Point out the part played by the Airways Traffic Control, the Airport Tower Operators, the airline dispatchers and communications personnel, and personnel of military air forces.

Illustrate proper method of giving weather information by radio telephone.

Discuss recent local weather conditions and forecasts, pointing out their record on synoptic maps.

Discuss meteorological causes and effects upon district of general local weather conditions such as days of annual sunlight and rain, amount of rainfall, prevalence of haze and fog, hours of daylight.

*Ground Instruction by Chief Pilot or Other Qualified Airport Personnel*

Discuss and demonstrate weather care of airplanes such as mooring planes in high winds, protecting pilot-static tubes from moisture, preventing formation of moisture in fuel tanks, checking water in fuel strainer, covering certain types of windshields to protect them from the sun, using carburetor heat in glides and during cold or wet weather.

Discuss and demonstrate weather effects on propeller and aircraft structure, de-icing equipment.

Discuss weather hazards of takeoff and landing on different surfaces.

Point out pilot's use of station pressure and sea-level pressure for setting sensitive altimeter. Call attention to dangers of altimeter errors in instrument flight. Review actual illustrative weather incidents in local or general flying.

Point out aviation's contribution to the general knowledge of weather. Indicate reasons for transfer of U. S. Weather Bureau from the Dept. of Agriculture to the Dept. of Commerce.

[10] If there is no Weather Station at the Airport, the class instructor or a qualified representative of the airport should give as much of the above as local facilities permit.

LESSON 9

**Weather[11] in Aviation under Direction of Flight Instructor, Twenty Minutes of Flight Experience Included:** (See page 166.)

*Ground Instruction by the Flight Instructor Prior to Flight*

Review airport procedure for securing weather information for proposed flight. Assist student in check.

Discuss up-and-down drafts. Ask student where they may be expected during takeoff and landing at that time. Verify during flight experience.

Discuss hazards in taxiing through puddles of water, and methods of taxiing, takeoff, and landing on muddy fields, snow-covered fields, and wet or icy runways.

Discuss meaning of a sudden 90-degree to 180-degree wind shifts as indicated by the wind sock.

Direct student in setting the sensitive altimeter to zero for the field.

*Flight Experience Under Direction of Flight Instructor*

Point out effects of vertical currents during takeoff and landing.

Point out loss of rpm when using carburetor heat and subsequent danger if used during takeoff.

Demonstrate up-and-down drafts by having student fly relatively low over various types of surfaces such as paved roads, wooded areas, rivers, ploughed ground.

Call attention to difference in rate of climb at altitude.

Point out vertical currents under clouds and near hills or mountains.

Point out method of estimating wind direction and velocity from cloud movements.

Point out method of choosing direction of flight to avoid thunderhead or thunderstorm on course.

Demonstrate use of two-way radio in plane to secure weather information during flight.

By means of an outside air thermometer, have student check temperature differences at a constant altitude and note terrain, clouds, and other circumstances which may cause the difference.

Fly under and above a cloud to demonstrate difference in bumpiness of the atmosphere.

*Ground Review Immediately after Flight under Direction of Flight Instructor*

By questioning student and answering his questions, call student's attention to reading of sensitive altimeter immediately upon landing and again later. Ask for an explanation of any difference noted. If at the last reading, the indication is not zero, determine a possible explanation for this deviation.

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[11] **This lesson will be given in the spring when weather conditions are variable, but greater opportunity for illustrations during flight may perhaps be possible if the flight is made during the middle hours of the day.**

Point out illustrations during the flight of the transfer of heat in the atmosphere, of variations in heat absorption by different types of ground and watch surfaces.

Explain reasons for difference in vertical currents below and above clouds.

Discuss adiabatic heat conditions and possible explanations of temperature differences noted at constant altitude during flight.

Discuss conditions under which three greatest weather hazards—turbulence, fog, and ice—might be met locally and how they might be anticipated.

page 172.)

LESSON 10

**Cross-Country Flying under the Direction of the Class Teacher and Flight Instructor, Ninety Minutes of Flight Experience Included:** (See page 172.)

*Ground Instruction by Class Teacher at School Prior to Day of Flight*

Supervise student's choice of route for a cross-country trip to include landing at two other airports where possible. If the previous flight experience has been from a small airport, however, he will learn more by landing at one larger control airport than at two of a familiar type. An alternate route for emergencies should be planned. Assist student to familiarize himself by means of his map with the terrain and prominent check-points along his proposed route, and ascertain that he understands map symbols without referring to the key.

Remind student of varying usefulness of different types of check-points.

Review the use of the navigational instruments and their errors.

Supervise student's determination of true and magnetic courses for each leg of his proposed flight. Remind him that he cannot determine a compass course until he consults the deviation card in the plane which he will use.

Point out variable character of wind and the necessity for constantly checking wind drift.

Review practical method of determining compass heading to fly, determining several check-points along the proposed route near to the airport, steering so as to keep two in line ahead, and noting the compass heading when no longer drifting off course. Caution that this heading must be checked at intervals for change in wind direction or velocity.

Recall necessity for altering route if weather conditions become unfavorable.

Review factors in determining flight altitudes to be maintained—visibility, ceiling, character of terrain and flight areas, air turbulence, necessity for keeping two check-points ahead in view if possible, choice of landing area in case of a forced landing, approval of flight plan by Airways Traffic Control.

Remind student of procedure and obligations in filing a flight plan.

Review radio range system and other radio aids to navigation.

Recall traffic rules for cross-country and for landing at larger airports.

Assist student in folding map and securing watch and other aids if needed in flight.

*Ground Instruction by the Flight Instructor Prior to Flight*

Check to see that student has made line inspection under proper supervision.

Assist him in checking on the fuel supply.

Check on student's report of weather for the proposed trip.

Check to verify or change student's choice of airports at which to land, route to be followed.

Check on his ability to read map symbols, and his determination of the compass course to fly.

Discuss operation and use of radio telephone and radio aids.

Point out any additional navigation and flight instruments required for instrument flight which may aid on the cross-country flight.

Review traffic procedure when landing at a strange airport.

Demonstrate filing with Airways Traffic Control the flight plan for contact flights prepared by the student. Remind him of the obligations its approval involves.

Check on condition and availability of student's map, and other equipment, when he is in the plane.

Supervise setting of sensitive altimeter to sea-level pressure by adjusting it for cross-country purposes to indicate the altitude of the field.

*Flight Experience under Direction of Flight Instructor*

Call attention to airport compass rose.

Demonstrate practical method of determining compass heading to fly or amount of crab necessary to hold plane on course. (Discussed under Ground Instruction by class teacher.) Have student try to hold that heading for a time. Assist him in maintaining straight and level flight so that he may attend to the compass and the terrain. Point out landmarks for student to locate on his map. Note corrections necessary because of drifting from course.

Demonstrate method of determining ground speed between check-points to estimate time of arrival. Have student use computer for solution.

Demonstrate action of the magnetic compass in turns on different headings.

Point out landing procedures at strange airports. Call student's attention to indicated altitude after landing and have him check it with figures on his map. Supervise student report of landing to ATC, in accord with flight plan approval.

Assist him to verify weather for remaining leg or legs of the flight.[12]

Call attention to varying weather conditions during the flight, reasons for

[12] Approximately one half-hour period for rest and inspection of the airport should be allowed. Encourage questions about first leg of trip before taking off on next leg. The time involved in the flight and other details will determine at which airport the extra time on the ground should be spent if the flight involves two strange airports.

bumpy air and vertical currents. Note cloud types, wind shifts, and method of locating high- and low-pressure centers during flight by determining direction from which wind is coming.

Lose the student by diverting his attention following the radio range or demonstrating suitable maneuvers. Assist him to locate himself by first determining fuel-time remaining, marking a reasonable area on his map where he may be lost, flying a constant heading toward an expected check-point for a definite time, and, if it does not materialize, trying another constant heading until a check-point is recognized.

Demonstrate use of radio telephone on radio range. Have student identify A or N signals and station signal by reference to map. If course is along an airway, fly so as to permit student to hear characteristic sound of on-course signal, twilight zone, and cone of silence. Demonstrate beam-bracketing.

Announce a forced landing and ask student where he would land. Simulate a forced landing to prove its suitability.

Assist student to plan approach to home airport so as to enter traffic properly and to determine the proper direction and choice of landing runway.

Demonstrate filing of arrival message to be transmitted to Airways Traffic Control.

*Ground Review Immediately after Flight under Direction of Flight Instructor*

By questioning student and answering his questions, have student recall check-points most difficult to identify, type of terrain over which it seemed most easy to become lost, procedures in finding oneself when lost, difficulty in holding magnetic compass on a constant heading in level flight in smooth air and in turbulent air, untrustworthiness of magnetic compass in turns.

Discuss importance of map-reading, especially symbols.

Ask student, whether, after the day's experience, he would choose identical routes for trips between the same airports, and his reason.

Determine what aspects of map-reading, dead-reckoning, radio flying, and cross-country flying in general seemed most different from his previous conception of them and why.

Check and sign student's log.

# High-School Aviation Courses in the States

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AVIATION education has established itself in the educational programs of all the states since 1942. When this number of the *Bulletin* was planned, the editor asked the supervisors of aviation education in each of the State Departments of Education to send comments and materials for inclusion in it. A number of responses have been received and are summarized here, along with a few reports from other states which have come to his attention through other sources.

Aviation education in high schools may be divided conveniently into three kinds of activities. The first of these is the infusion of materials on aviation into all subjects of the regular curriculum wherever the facts and implications of aviation can appropriately be used to modernize or enrich those subjects. One could scarcely teach social studies these days and at the same time ignore the airplane and its implications for states, nation, and the international community. Most of the principles of physical science find modern expression in aviation and scientific developments related to aviation. All secondary schools engage in this program of infusion more or less, whether or not their teachers make a conscious effort to use the dynamics of aviation to improve their instructional content and methods.

The second kind of secondary-school activity in aviation education can be found in aviation-centered industrial arts and vocational courses. Some of these have been discussed in the article by Mr. Roy G. Fales, Supervisor of Industrial Arts, State Education Department, Albany, New York, to be found in this issue of *The Bulletin* on pages 191-204. These courses are found quite generally throughout the country, but no summary of their distribution or number is available for many states.

The most widespread and numerous of high-school courses in aviation are found under the titles of Science of Aviation, Aviation, Science of Aeronautics, Aeronautics, or the older and less appropriate designation of Pre-Flight Aeronautics. These are regarded as science courses, and are usually taught with laboratory exercises. Most educators regard the courses as a part of education in modern science suitable for students whether or not they intend to become flyers. They are usually regarded as only incidentally military pre-induction courses, although they are excellent for this purpose. The different viewpoints of the various states on this point are reflected to some extent in this summary.

Research by the American Council on Education discloses that approximately ninety-six per cent of colleges and universities accept high-school aeronautics as elective subjects in science, with a majority recognizing it as a laboratory science. The state by state "roundup" which follows refers to science of aeronautics courses except when other types of courses are clearly indicated.

STATE REPORTS

In **Alabama**, fifty-nine high schools offered regular classes in aeronautics during 1943-1944. In this state various non-school groups interested in the stimulation of aviation education have given effective support to the educational authorities. As an illustration of this, in the spring of 1944 prize-winning students from nineteen high-school aviation classes in the city of Birmingham and Jefferson County were given day-long cross-country inspection flights through the courtesy of Southern Airways in recognition of their excellence in classroom work.

In **Arkansas**, lack of qualified teachers has curtailed opportunities in aviation for high-school students, so that in 1943-1944 there were only twenty-nine high schools offering the courses to 406 students. The State Department of Education has assumed active leadership in the field in publishing courses of study, encouraging the further education of teachers and similar activities. As teachers become available there will, no doubt, again be an increase in the amount of instruction offered.

In 1941-1942 only a dozen or so of **California's** high schools taught aeronautics. During the 1943-1944 school term, 194 high schools enrolled 4,661 students in science of aeronautics classes and in addition thirty-two schools had 2,288 students in classes of aircraft maintenance.

In **Connecticut**, an accurate and detailed report compiled by the State Department of Education shows that seventy of the ninety-nine public senior high schools taught regular science of aeronautics courses in 1943-1944, an increase over the number of the preceding year. Classes were somewhat smaller, however, enrolling 1405 compared with 1577 in 1942-1943.

All senior high schools in the **District of Columbia** offer courses in the science of aeronautics; in the current (1944-1945) year, there are 525 students enrolled in these courses in the eleven schools. There are also vocational aviation courses in mechanics.

The **Florida** State Department of Education reports that it is possible for schools in that state to offer credit for work in aviation education. Three Florida counties are now granting one and one-half units of credit for not less than 288 hours of aviation instruction outlined by the Civil Air Patrol.

A report of June 15, 1943, shows that an inquiry to 762 high schools in **Illinois** resulted in replies from 675. Of these schools, 248 had aeronautics classes enrolling 7,105 students; 307 indicated an intention to offer the course in 1943-1944.

In **Kansas**, 130 high schools offered aeronautics classes in 1943-1944 and, as in most states, problems of teachers certificates, academic credit for the aviation courses, and other matters, that invariably come up, have been effectively solved.

Despite serious shortages of teachers, ninety-one **Maine** high schools conducted aeronautics classes in 1943-1944.

In **Massachusetts**, 204 of the 259 public senior high schools and a high percentage of independent preparatory schools offered aeronautics classes in 1943-1944. This represented a small increase over 1942-1943.

In 1942-1943, thirteen high schools in **Minnesota** were selected to inaugurate a program of glider building under the direction of the State Supervisor of Trade and Industrial Education. Teachers were given special courses at the University of Minnesota and the courses of study included flight instruction, as well as the building of gliders. This program was financed by the state and was terminated on July 1, 1943, by action of the State Legislature, when no funds were appropriated for its continuance. Some programs in airplane engine mechanics, aircraft construction, and radio service and communications have been carried forward in the larger centers in Minneapolis and St. Paul as parts of the Smith-Hughes programs. Science of aeronautics courses have also been conducted in high schools throughout the state.

In **Mississippi**, the subject of aeronautics has proved very popular in high schools and is regarded by the State Department of Education as having a permanent place in the high-school curriculum of the state. Sixty high schools offered courses in 1943-1944, despite lack of a sufficient number of qualified teachers.

**Missouri** currently reports 2300 students of aeronautics in 114 public high schools, in addition to some work in vocational aviation courses.

In **Montana**, fifty-four high schools offered courses in aeronautics for a total of 723 high-school boys and girls in 1943-1944; a decline from seventy-three high schools and 1131 students in 1942-1943. The State Department of Education has been active in stimulating further preparation of teachers and in giving assistance to the aviation courses in the high schools throughout the state. The high-school courses are regarded as important subjects for the postwar era which will become more effective when larger numbers of competent teachers of such subjects become available.

**Nebraska** developed an outline of an aeronautics course for high schools several years ago and has been active in aviation education at all school levels. Approximately 150 high schools offered aviation courses in 1943-1944. Among the activities in Nebraska has been the publication of a periodical for elementary schools called *Exploring Aviation* and sponsored jointly by the University of Nebraska, the Nebraska State Education Association, the Nebraska State Department of Public Instruction, Nebraska State Aeronautics Commission, and United Airlines. Correspondence courses in aviation have been made available to high-school students for several years.

In **New Hampshire**, forty public high schools enrolled 759 students in aeronautics courses during 1943-1944. These figures represented a small decline from forty-three high schools and 954 students for 1942-1943. Private schools in New Hampshire, as in other states, have also offered many such courses. As in many other states, programs of studies in aeronautics have been issued

by the State Department of Education. Special attention has been given in New Hampshire to the preparation of teachers, some of whom have been given opportunities for flight experience without personal cost by the New Hampshire Aeronautics Commission.

In **New Jersey**, aeronautics courses have been widely regarded as primarily for pre-induction purposes. The State Department of Education reports that: ". . . survey just completed included responses from 180 of the 187 senior high schools of the state. We note that in 1942-43, ninety-four schools enrolled 3,078 pupils in pre-aeronautics. In 1943-44, ninety-five schools enrolled 2,437 pupils, and for the current year, 1944-45, we find only 1,707 students registered in sixty-two schools. There still continued to be model airplane and airplane spotting clubs, but principals seemed to feel that the best preparation for service in the air forces is a thorough study of basic subjects. This practice seems to meet the approval of pre-induction training Army officers. Schoolmen have felt for some time that a specialized type of work in high school has not been generally followed up in the armed services." The decline shown in this state seems to reflect the emphasis placed upon the pre-induction purpose of the classes.

**North Dakota** enrolled 735 high-school aeronautics students in fifty-one

**Anthony Schwerkolt of the Isaac Young High School of New Rochelle, New York, leads the discussion and study of magnetic deviation in a class period.**

schools during 1943-1944. The State Department of Public Instruction prepared a course outline as early as August, 1942, and has been active in the teaching of aviation education since that time. There is a serious scarcity of qualified teachers.

There were approximately 9,000 high-school aeronautics students in 425 **Pennsylvania** public high schools in 1943-1944. Regular courses were also offered in numerous independent preparatory schools.

**Texas** has been one of the leading states in aviation education, enrolling an estimated 12,000 high-school boys and girls in 1942-1943, the last year for which statistics are available. The State Department of Education has been particularly active in stimulating instruction in aviation education in the many high schools in Texas.

In the state of **Vermont**, in which many high-school courses are given, special aid to aviation education has been given through the kindness of Col. and Mrs. Robert K. Haas in memory of their son, Lt. (j.g.) Robert K. Haas, Jr., a naval aviator who lost his life while piloting a torpedo plane in the North Atlantic. A considerable amount of money from this bequest has been used for such activities as exhibits at the Fleming Museum at the University of Vermont in Burlington, the distribution of aviation books in the free distribution public library in Montpelier, the loan of motion picture films, film slides and projectors, and other educational aids through the Secondary Division of the State Department of Education and through the Fleming Museum, as well as the free distribution of aviation materials through superintendents and supervisors. This is an outstanding example of the possibilities of philanthropy in the field of aviation education.

In **Washington**, more than half the high schools in the state offered the course in 1942-1943 and large numbers continue to do so. Courses of study have been prepared by curriculum committees sponsored by the State Department of Education.

**West Virginia** prepared a state course of study for high-school aeronautics in 1942. Interest has continued and sixty-eight high schools offered the courses during the 1943-1944 school year, in spite of a serious lack of qualified teachers.

# Aviation Education Program in New York State

ROY G. FALES
*Supervisor of Industrial Arts*
*State Education Department, Albany, New York and the Staff Members*

## Junior Aviation Program

AVIATION EDUCATION in New York state public schools is gradually becoming a program[1] which will begin in the elementary school and terminate with the preparation of men and women for gainful employment under the direction of Dr. Lewis A. Wilson, Deputy Commissioner for Education, and Mr. Oakley Furney, Commissioner for Vocational Education. It is divided into two main types of work. The first is called junior aviation and consists of courses for boys and girls in the general education classes of the elementary, junior, and senior high schools. This is a form of industrial arts work. The second includes the courses which are designed to train pupils for employment. This is vocational education.

### COURSES OFFERED

The junior aviation education is a part of the industrial arts shop program and includes the following types of work:

Elementary school—Air toy construction and study

Junior-Senior High School—Flying model aircraft construction, and scale model aircraft construction

Senior High School—Junior aviation maintenance and repair, glider construction, and flight instruction

### FLYING MODEL AIRCRAFT CONSTRUCTION COURSE

The building and flying of model aircraft is a logical approach to the study of aviation. Pupils learn to be cognizant of the many factors involved in aircraft construction such as weight, stresses, and balance, through actually handling materials. Aircraft nomenclature becomes an integral part of their vocabulary. While flying the models, pupils begin to think about what keeps the model in the air. Their curiosity is aroused and they begin to make inquiries as to why and how it flies. This leads them to study aerodynamic principles and the laws of flight. From this point on, the horizon of activity and study is unlimited.

The elementary-school aviation work is just beginning to develop. It is to be organized largely around simple air toys such as paper gliders and other simple articles. These will serve to provide construction work and to encourage the observation and study of aviation activities. It will eventually be taught by the classroom teacher with the assistance of industrial arts and science specialists in the school.

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[1] This report on aviation education in industrial arts and technical and vocational education, on pages 191-204, differs from reports of the six other states described on pages 12-190 in that it is a description of present programs and practices in New York State. Reports of the other six states grew out of conferences of educational and aviation leaders in formulating and recommending a program in aviation education on a state-wide basis for all areas of secondary education.

Flying model aircraft work should be an integral part of every industrial arts shop program. It should be included either as an activity of the seventh-, eighth-, or ninth-grade general shop course or as a full-year course. It is the fundamental aviation course.

Pupil interest in model airplane work has always been very high. What has been lacking is directional control. When this is provided through the selection of a graded series of suitable projects, the pupil is almost certain to produce successful flying models and to continue his interest in aviation.

As a part of the Junior Aviation Program of New York state, a new course of study has been prepared for use in all schools. It is the "Junior Aviation Flying Model Aircraft Course of Study." While designed primarily as a unit aviation course to be offered in the senior high school, much of the content is adaptable to the seventh-, eighth-, and ninth-grade general shop classes.

In addition to the suggested course organization including lesson topics for demonstrations and related lessons, the course contains several sections of particular interest to shop teachers. One of the outstanding features is a set of full-size plans for eleven different model planes, ranging from a simple balsa glider to a gasoline-powered model. Included also are page reprints from model aviation magazines. These provide the instructor with related aviation information and helpful construction ideas and suggestions. To aid him further in the selection of suitable shop projects, a graded list of airplane models and kits is included in the project section.

During the 1944 summer session a course in flying model work was offered at the State Teachers College in Oswego. The aim of the course was to prepare teachers for the teaching of model aircraft work. More teacher training work of this nature should be organized in the very near future.

No unit of work in flying model aircraft would be complete without an actual flight test or model-plane contest. Therefore, the New York State Exchange Clubs in co-operation with the State Education Department are sponsoring and organizing model-plane contests of various types. Intraschool, interschool, and regional indoor contests will be held during the 1944-45 school year. They will be followed by a state-wide contest held during the month of June.

The study of aviation through the building and flying of model aircraft is one of the most valuable and satisfying experiences which a school can offer to all boys and girls.

### SCALE-MODEL AIRCRAFT CONSTRUCTION

Another plan of model work which generates considerable interest and stimulates the study of aviation is the construction of scale-model aircraft. The value of this work and the natural interest which many individuals develop in it is indicated by the sale of such kits in ten-cent stores, hardware stores, and hobby shops.

The scale-model identification aircraft made for the Navy training centers

by New York state boys were valued at better than $5,000,000 and numbered 87,000. This same type of model, painted in attractive colors will fascinate thousands of pupils. New York state developed a mass-production plan for model aircraft utilizing jigs, which will make an excellent industrial arts exploratory project. Scores of plane models can be made by this plan and each and every pupil can own a beautiful model of a fighter bomber or passenger plane. For the pupil who likes pretty planes this is the stimulus which will lead him to study aviation. The building of scale-model aircraft will be used to interest boys and girls in aviation more fully in the future.

### JUNIOR AVIATION MAINTENANCE AND REPAIR COURSE

The surprise of Pearl Harbor and the resultant demand for airmen of all types brought about by the war caused a country-wide awakening to our aviation needs. The legislature of New York state responded with an appropriation for the development of aviation education in the public schools. Since 1942, this state has appropriated $240,000 for aviation education. The exact purposes of this work, as it was defined by the State Education Department, were as follows:

> To educate all secondary youth as to the importance of aviation in modern life and the significant part which aviation has in the present war effort
>
> To prepare properly selected secondary youth for entrance to the various aviation occupations
>
> To develop a program of aviation education to meet the needs of pupils in the postwar period.

With these objectives in mind, rules and regulations were defined for the use of state aid. Fifty schools in thirty-nine communities were selected as experimental centers. To each of these schools was given a grant of $1,700 for the purchase of necessary aviation equipment. The list of equipment that could be purchased with the grant was as follows:

### JUNIOR AVIATION—SHOP AND LABORATORY APPROVED EQUIPMENT LIST

1 Complete airplane engine, not less than 40 H.P. and propeller in operating condition
1 Rack or stand and necessary protective screening for engine
1 Airplane fuselage covered or uncovered
1 Airplane wing of modern type with aileron covered or uncovered
1 Map illustrating each of the following projections: (5 maps total)—Polyconic, Lambert conformal conic, Mercator, Gnomonic, and Polar
1 Radio sending set, automatic, for classroom instruction in radio code reception
1 Magnetic compass—aviation type
1 Modern landing gear
1 Set of empennage surfaces
1 Sextant
1 Mercury barometer
1 Aneroid barometer
1 Thermometer
1 Thermometer minimum temperature
1 Sling psychrometer
1 Rain gauge
1 Thermograph
1 Barograph
1 (12-inch) globe with world map
1 (12-inch) globe plain
1 Mark VII computer

1 Thermometer maximum temperature
1 Anemometer
1 Anemoscope
1 Small wind tunnel
1 Air speed indicator
1 Altimeter

### SOME PROCEDURES

Outlines of course content were prepared by aviation specialists in the following types of work: Theory of Airplane Structures, Aerodynamics, Aircraft Engines, Meteorology, Communication, Elementary Air Navigation, and Human Factors in Flight.

The fifty experimental centers equipped their shops and organized classes which in most cases met for three hours daily. Part of the period was devoted to shop work in which the pupils disassembled, assembled, adjusted, and repaired aircraft engines, structures, landing gear, and instruments. About one third of the daily period was devoted to the study of the theory of aviation and the equipment and apparatus for flight. In addition to this the pupils studied map making and reading photography, meteorology, radio communication, and repair. The entire program was designed to prepare boys to make their way successfully in the armed forces.

Some of the schools selected the pupils very carefully. Criteria for selection included physical condition, mental ability, interest in aviation and school records. Many of the schools gave the tests described in "Are You Fit To Be A Pilot", written by Ermin L. Ray and Stanley Washburn, Jr. In many of the centers a serious attempt was made to select and enroll only those who showed some promise of being able to fly.

Since September, 1942, war conditions have changed. The Army and Navy have been able to train all of the airmen they need and the drastic shortage has been relieved. The effect of this change has been reflected in the aviation courses offered.

### PRESENT COURSE TRENDS

At the present time there are two junior aviation maintenance and repair courses being used. The first is for the beginning group and the second is an advanced course. Very few schools use the advanced course in view of the fact that the beginning course is in reality advanced in the industrial arts course offerings.

The beginning course consists of an outline of operations, jobs to be performed by pupils, and lesson topics to be taught by the instructor together with a bibliography and several floor plans. The amount of material outlined is slightly greater than can be taught in one year. Teachers are allowed considerable freedom in the selection of the pupils' work and the lessons to be presented. The pupils usually work in small groups or individually on the various parts of the plane. This is made necessary by the limited amount of equipment available in any given shop. Through the informal rotation of jobs, pupils have an opportunity to work with all parts of the aircraft structure, engine and instruments, becoming familiar with the physical equipment.

### SHOP DESCRIPTION

Junior aviation maintenance and repair shops vary greatly in size. The best of the shops have a floor area of about 2,000 square feet. They are well filled with a complete airplane, several engines, extra wings and fuselages, propeller stand, and the various kinds of work-center equipment.

Wells are used for storage of materials, equipment, tools, aviation charts, pictures, diagrams, exhibit panels, and other types of educational materials. In New Rochelle the pupils painted diagrams of the many different kinds of planes on the walls. Historical aircraft and modern figures, bombers, and transport planes are all given adequate treatment. The classes which designed and painted these murals of necessity studied planes. Succeeding classes will study the murals.

### AVIATION WORK CENTERS

Every shop teacher tends to group equipment according to type. This tendency has been encouraged in the aviation shops. Work centers have been developed for engines, meteorology, navigation, communication, model work, and aerodynamics. Such centers call for a concentration of equipment, tools, pictures, charts, and appartus.

*Meteorology.* — The purpose of this center is to stimulate the pupils to study weather conditions and make weather predictions. This unit consists of a bench or lathe placed near the wall. Over the bench is a bulletin board for daily weather reports. Weather recording instruments are mounted on the same panel. The barometer, anemometer recording dials, and wind-direction indicator are mounted here. On the roof or on a platform outside of one of the shop windows, the hygrometer, wet and dry bulb thermometers, and maximum and minimum thermometers are mounted. Some schools mount instruments in a shelter on the roof or in a nearby field. The anemometer should be erected on the roof, so that it can be connected to the recording dial in the shop. Either mechanical or electrical connections will provide the needed readings.

Many of these instruments have been made in the school shop. They need not be expensive. Pupils use them for keeping a record of the weather conditions on the basis of which they should be able to make weather predictions which can be compared with the official predictions. By so doing they will learn considerable about local and country-wide weather forecasting.

*Aerodynamics.* — This work is easily presented in a center including a bench, wind tunnel, and shelving on which airfoils, manometers, air speed indicators, and other experimental apparatus is stored. While the miscellaneous apparatus is helpful, the wind tunnel is used to demonstrate and test drag, lift, and air turbulence. Many experiments and demonstrations of great value are connected with this unit.

*Communication.* — In the communication center there is a wealth of radio, telegraph, telephone, and code sending and receiving equipment. Here

pupils build communication apparatus of various kinds and finally use it to send or receive messages.

*Aircraft engines.* — The engine work center is large. It usually consists of several engines for shopwork and a wire cage in which at least one small engine can be started for testing purposes. The cage surrounds the propeller to prevent accidents.

Extra engine parts such as generators, carburetors, and pistons are also necessary. Such engine units are sometimes set up for testing and at other times are used only for dis-assembly and assembly. Pupils work with them, draw diagrams of how they are constructed, and study their operation.

*Navigation.* — This particular type of work is a little more difficult to develop into a good work center although maps, charts, dividers, parallel rules, and a globe allow pupils to plot a course and gain some concept from actual work as to how planes arrive at their destination.

### FLIGHT INSTRUCTION AUTHORIZED

The legislature of the state of New York passed a law during the spring of 1944 making an appropriation for flight instruction. According to the law, local school boards may purchase or rent necessary equipment for offering of preflight, glider flight, airplane flight, and junior aviation courses. The state will reimburse local districts for one half of approved expenditures but not exceeding a total amount of one thousand dollars.

This places the initiative for offering flight with the local school officials and board of education. They are free to make arrangements which meet local conditions. In this way interest and responsibility for flight are closely related and directly controlled. Many schools have indicated interest in offering flight instruction and are expecting to do so during the current school year.

### GLIDERS IN NEW YORK STATE PUBLIC SCHOOLS

During the summer of 1942 when the military forces became interested in gliders, a teacher training course in glider construction was offered at Cornell University by the State Education Department. The course was attended by twenty-five industrial arts teachers who were interested in aviation. The majority of the men organized glider-construction programs in their own school shops following the summer session at Cornell University.

The men in charge of the Cornell course designed a ground trainer and used it as a project for construction. It embodied most of the construction problems of a man-carrying glider or sailplane and was equipped with the same type of control mechanism. It was fitted with a wide two wheeled landing gear and the wings were made too short for actual flight.

In operation the ground trainer was towed behind an automobile. At low speeds the tail would lift from the ground and the trainer was piloted in the same manner as a real glider coming in for a landing.

The ground trainer proved to be so satisfactory as a construction project, and as a vehicle for giving preliminary training to pupils, that a monograph

on ground-trainer construction was written in the National Defense Curriculum Laboratory at Cornell University. The monograph contains complete plans for the ground trainer and illustrated instructions for performing the various jobs, operations, and processes in glider construction.

A number of glider-construction classes in the public schools built and operated ground trainers during the school year of 1942-43.

Following the development of the ground trainer, the State Education Department endeavored to find suitable plans for a glider that could be built in an industrial arts shop. Plans for a glider that would meet Civil Aeronautics Authority specifications for a certificate, were not available. Plans for the Kirby Cadet, a British glider, were finally obtained. Permission was obtained from the designer and plans were reproduced under the supervision of the State Supervisor of Glider-Construction courses.

The Kirby Cadet is a training glider built of wood and fabric. This type of construction makes it an excellent aircraft woodworking project for high-school pupils. Most industrial arts shops have woodworking equipment with which advanced pupils can build a glider while studying aircraft woodworking.

The glider serves two purposes: it provides a good construction project at a reasonable cost and a ship for flight training. This combination will make possible economical flight training as well as shop training for boys and girls of moderate financial means. Many will be able to fly because of the low cost of the equipment and instruction.

A number of these gliders are being built in various schools throughout the state. In several of the centers the ships are nearly ready for certification.

During the summer of 1944 the State Education Department conducted a six-week course in glider flight instruction at the Chemung County Airport under the supervision of the Elmira Faculty Glider Club. The course was attended by industrial arts teachers who were interested in flight and ground-school training.

The program was so arranged that half of the student's time might be spent in actual flight training at the airport and the other half in glider construction at the Elmira Aviation Ground School.

The flight training was given in a Franklin utility glider. This glider was used for solo flights after the students finished ground tow work in a ground trainer.

At the present time the New York Central School in Retsof is the only school where glider flight instruction is being given. Mr. Wesley Hammond, one of the men who attended the course at Cornell University in 1942, has pioneered the work in Retsof. The program has been very successful. The school owns a glider and rents a local airport for industrial purposes.

Students desiring to take glider work in this school must have a prerequisite of one unit of credit in industrial arts work before entering the glider course.

The prospect of glider construction and flight becoming a major interest or sport in the postwar period is dependent upon the availability of satisfactory plans for training-gliders. Ground trainers and primary and utility gliders must be designed for easy construction by high-school pupils. If such designs, materials, or kits are available at a cost of about three hundred dollars ($300) for each ship, glider construction and flight as high-school courses will develop well. Such courses will feed into the potential sport of gliding. The developments of the plan seems to be the only method available for offering inexpensive flight at present. It offers a tremendous development to aviation providing the proper conditions can be developed.

## Technical and Vocational Aviation Program[2]

### SCOPE OF PROGRAM

The technical and vocational program overlaps the junior aviation program in the secondary school and extends upward to include the training and retraining of mature workers and returning war veterans. Both types of work in their many variations are designed and organized to produce workers who are well prepared for gainful employment in some plan of the aviation industry.

Courses are offered in day technical and vocational schools. Afternoon, evening, and night courses are offered in these schools and also in selected high schools throughout the state. Still other courses are offered in industrial plants where special equipment not available to schools is installed.

### TECHNICAL AND VOCATIONAL PROGRAM

The following courses are included in this program:

Technical High-school Aviation Courses
Aviation Instruction for Defense Industries
Aircraft Vocational Program
Training for the Home Army Air Field
Veterans Training
Technical Institutes.

### TECHNICAL HIGH-SCHOOL TRAINING FOR THE AVIATION INDUSTRY

One type of training for the aviation industry can best be developed in a technical high school. This has been demonstrated by the work done in the Brooklyn Technical High School. This school as well as other technical high schools has been, for more than 20 years, training technical assistants to engineers and production supervisors in the field of machinery manufacturing. In these courses the emphasis has been on the mathematics, science, and technology rather than upon the skill of the job. Graduates of these courses have worked as draftsmen in engineering departments and as testers in laboratories

[2] This section was prepared by Roy G. Fales, Supervisor of Industrial Arts, William N. Fenninger, Supervisor of Technical Education, and Michael F. Steffen, Consultant for Aviation, State Education Department, Albany, N. Y.

or in production departments. Some have worked as assistants to foremen and production control supervisors.

Although the aviation industry was not large about 1936, Mr. A. L. Colston, the principal of Brooklyn Technical High School, himself an engineer, saw that there were similar positions as junior engineers and technicians in the airplane industry. There were positions as draftsmen, inspectors, computers, testers, and foremen in airplane manufacturing companies for which a college course in aeronautical engineering is not needed and for which a trade school course in aviation mechanics is not proper preparation. Accordingly, in his new technical high-school building he set up two airplane shops, an airplane drafting room, and a navigation and meteorology laboratory. For use in other courses the school had physics and chemistry laboratories, strength of materials laboratories, machine shop, woodworking shop, and sheet-metal shops.

To assist in the task of planning and carrying out a technical course in aeronautics, two aeronautical engineers were added to the teaching staff. One was an airplane designer; the other had been in charge of production in an airplane manufacturing plant.

A four-year technical course was set up beginning with the ninth grade. The subjects in the first two years were the same as in the technical mechanical course. During the eleventh and twelfth grades, however, the pupil was permitted to specialize in aeronautics.

The present curriculum contains the following subjects:

| *Subject* | *Units*[a] |
|---|---|
| American History | 1 |
| English | 4 |
| Civics and Economics | 1 |
| Algebra | 1½ |
| Plane Geometry | 1 |
| Trigonometry | ½ |
| Solid Geometry (elective) | ½ |
| Industrial Processes | 1 |
| Physics | 1 |
| Strength of Materials, Theory, and Laboratory | 1 |
| Chemistry | 1 |
| Freehand Drawing | ½ |
| Machine and Airplane Drawing | 1½ |
| Airplane Theory and Design | 1 |
| Machine Shop | ½ |
| Wood Shop | ½ |
| Foundry and Pattern Shop | ½ |
| Airplane Construction Shop | 1½ |
| Airplane Engine and Instrument Laboratory | 1½ |
| Total | 21 |

[a] A unit of credit is earned for a prepared subject like mathematics which is given five periods per week for a year. For an unprepared subject like machine shop, ten periods per week are required.

Inasmuch as the state requires only sixteen units for a college-entrance diploma it is obvious that this course is not an easy one. In order that the pupils who complete this course may be eligible for a state diploma, he must pass a comprehensive technical examination covering all of the instruction given in the field of aeronautics.

While some pupils had taken part of the work previously, the first class to complete the whole curriculum was graduated in June, 1940. There were forty-one in the class. In October, 1943, records were available of the first two years work of thirty-seven of these graduates. All of these started work at graduation in airplane manufacturing. The average pay in the first job was $22.34 per week. At the end of two years (1942) the average pay was slightly over $51 per week.

None at the end of two years had failed to advance. The work of the thirty-seven was distributed as follows: 3 foreman, 7 lead men, 9 inspectors, 6 draftsmen, 5 stress analysts, 3 tool designers, 1 research worker in a plastics laboratory, and 3 had gone to technical universities.

While the objective of the curriculum is preparation for employment and not preparation for college, a study of the curriculum shows that graduates are well prepared to undertake engineering college study. The records of graduates of this and other technical courses gives evidence of the adequacy of their preparation for engineering college, because the percentage who failed in college is less than half that of the national average of engineering college students.

While the total number of persons employed in airplane manufacturing will undoubtedly decrease after the war, it was the consensus of opinion of the representatives of the airplane manufacturers at a conference held in Buffalo in June, 1944, and another held in Brooklyn a few months later, that there would be in the postwar period a need for young men with a technical high-school training in aeronautics similar to the course described here.

### AVIATION INSTRUCTION FOR DEFENSE INDUSTRIES

During the early part of the war, five large aircraft plants in the state, which were expanding rapidly, needed workers trained for the aircraft industry. To aid them, ten defense schools were organized.

To make sure that workers would not be drained from other war plants, these defense schools were located in areas where there were few defense plants or where there was no manpower shortage, as in the Adirondack Mountain Region and in the South Central Tier of the state. Then, at the end of the training periods many students were transported to distant aircraft plants for employment.

The training programs set up by these schools aimed to supply trainees to the aircraft plants. Courses were from five to ten weeks in length, depending on the need of the industry. Training was given in aircraft [illegible]eting, aircraft fabrication, aircraft metal parts assembly, aircraft inspection, and aircraft blue-

print reading and drafting. Most of the students were taught to perform one or two operations.

Approximately 80,000 workers were trained in the aircraft defense schools. These semi-skilled workers were able to adapt themselves quickly to the new specialized jobs and thus assist the aircraft plants in producing their airplane quotas.

About one half of the defense schools are still in existence. Naturally they are in the areas near the plants where individuals desire either pre-employment or upgrading training.

The public schools of New York state also were called upon to train workers for employment in the aircraft industry. Many high schools conducted special classes. They trained supplementary workers in such subjects as inspection, blueprint reading, and drafting. Most classes were conducted in the late afternoon and evenings. This enabled persons who were employed, either in war emergency jobs or other work, to receive training while still working. Most of them spent from ten to fifteen hours a week in classes. Approximately 200,000 aircraft workers were trained in supplementary programs.

"In-plant" training programs have been conducted in many aircraft factories under the direction of the local public school department. The establishment of these programs in plants was desirable because equipment similar to that on which individuals are required to work could not be made available in school buildings. By conducting classes in the factories, regular equipment which is idle at the end of the day can be put into use for training activities. "In-plant" classes are becoming more popular. At present there are more of them than at any time during the war period. A good example of this type of training may be seen at the Bell Aircraft Corporation at Niagara Falls.

### AIRCRAFT VOCATIONAL PROGRAM

Regular vocational schools throughout the state operated aircraft training courses also. At the present time, vocational schools in six areas are teaching aircraft subjects. The Burgard Vocational High School in Buffalo is the largest school of its kind in the western part of the state. It is especially well equipped and is offering training in practically every aviation subject, including Link Trainer work.

Another vocational school, operated by the Syracuse Board of Education, is located at the Syracuse Airport. It has direct field contact so that airplanes can be brought into its hangar. Maintenance-work subjects are taught. This school has been of assistance to the Civil Air Patrol which operated nearby.

Vocational aircraft training is developing very rapidly in the Rochester schools. At the present time, three schools are equipped to handle aircraft engine and airplane maintenance work. Enrollment in the evening classes has been growing steadily.

The southern New York state area is served by a vocational school at Elmira. The school is well equipped and offers an A and E mechanic course

certificated by the Civil Aeronautics Administration. Burgard in Buffalo and the school in Syracuse also are certificated to offer these courses.

In the metropolitan area, aircraft training is offered in three schools. They are the Manhattan High School of Aviation Trades in the center of New York City, the Aviation Trades Center in Brooklyn, and the East New York Vocational High School in East New York. All of these schools are well equipped to do an excellent job of training in a variety of aircraft subjects.

The Mineola Vocational School is a new aviation school which is developing on Long Island at Mineola. It has grown out of the state defense schools originally located at Freeport. It is offering courses in aircraft engine repair, airplane maintenance, aircraft electrical work, propellers, aircraft sheet metal, and aircraft welding. During the past year and a half the enrollment has grown to approximately 400 students. A superior job is being done in the training of mechanics for the Gruman, Columbia, and Republic aviation companies. At present the Mineola Vocational School is the only aviation vocational school on Long Island and it shows good promise for postwar development.

### TRAINING FOR THE ROME ARMY AIR FIELD

The Rome Army Air Field requested the State Educational Department to set up specialized and general training programs in several sections of the state. Accordingly, three "Off-Reservation" schools were established. They are located in Syracuse, Utica, and New York City. A state supervisor co-ordinates the work of the Rome Field with these schools.

The schools operate eight hours a day and five days a week. Individuals, who will eventually work at Rome, are enrolled in classes and receive $1200 a year while in training. Courses vary from four weeks to three months in length, depending on the subject in which training is given. The subjects taught in the General Aircraft Mechanics work are as follows:

Familiarization of Tools
Familiarization of Materials
Aircraft Engine
Aircraft Maintenance
Aircraft Hydraulics
Aircraft Propellers
Aircraft Electrical Work

The above subjects are given to mechanic learner groups to acquaint them with nomenclature and the various operations. The aircraft engines and airplanes which students work on are, in most cases, identical to those that are being flown by the Army.

For a while the program was confronted with the problem of recruitment, but all classes maintained fair enrollments. Now an increasing number of students of higher type are entering the classes, the reason being that some airplane subcontractors and other war plants are closing, making available new personnel for training and assignment to the Army Air Field. Approxi-

mately 4,000 men and women have already been trained for the Army Air Field Maintenance Division.

In addition to the work which is being done in these "Off-Reservation" maintenance schools, another large program, known as the "On-Job" program, has been established at the Rome Field. This program enables 350 mechanics, who are employed, to continue their training one hour a day with pay.

Vestibule schools also have been set up at the Rome Field. In them an individual remains in full-time training until he qualifies for the prospective job for which he is being trained.

Fifty per cent of the students who were trained were young girls and boys, ranging in age from eighteen years to twenty-one years. The schedule now requires that the number of trainees be increased at the Utica and Syracuse schools. No doubt, an additional shift will be inaugurated in both cities.

It is likely that the entire program now in operation will increase until the end of the war, due to the large labor turnover at the Rome Field. The entire educational program is supervised by several representatives of the State Educational Department who are stationed at the Field.

### VETERANS' TRAINING

The aviation training departments in New York state have adequate facilities and equipment to do a good job of training veterans. There are already a few aircraft classes in which returned soldiers are receiving training. It is expected that in the near future many of the shops used for war-production training in special defense schools and in the vocational schools will be used for veterans' training.

All forms of aviation activity are expanding.

**Gwyn Deyoe and Warren Richards, two students of the Glenn Falls, New York, High School Aviation Shop are shown working on a Continental engine in the shop.**

Municipal airports are being enlarged and many new airports are being developed on war-emergency government airport sites. The airlines' transportation operation will increase at the end of the war when materials equipment will be available and many private fields will also develop. Increased opportunities will open in the commercial aircraft industry which will absorb persons who are qualified in the new skills which will be needed. The returned veteran should find an opportunity for work in this program.

### TECHNICAL INSTITUTES

The state of New York is anticipating the organization of an extensive technical institute program as soon as the war ends. This type of training is designed to give high-school graduates two years of additional work on a technical level. Academic high-school or vocational high-school graduates who have had two years of specialized technical training, on a post high-school level, are needed for many junior technical positions. Many technicians are needed in industry who have more technical education and training than high-school graduates.

Several technical institutes will be located in the upstate area outside of New York City. Five already in existence will be expanded. One of the new institutes will specialize in aeronautical subjects. It probably will be located in the central part of the state preferably at an airport where airplanes can be flown in and out. Temporary plans indicate that the building will be designed like a hangar with shops and classrooms on three sides. Shops and classrooms for teaching the following specialized subjects are being considered:

| | |
|---|---|
| Aircraft Sales | Aircraft Propellers |
| Meteorology | Aircraft Electrical Work |
| Air Navigation | Aircraft Machine Work |
| Aircraft Engine Repair | Parachute and Fabric Work |
| Aircraft Maintenance | Aircraft Plastics |
| Aircraft Sheet Metal Work | Piloting |
| Aircraft Fabrication | Aircraft Photography |

In addition to the one large aeronautical institute, training in specialized aircraft subjects will be made available in other institutes where such training will be limited to supplementary or upgrading courses. It is believed that youths just out of high school should be directed to the specialized aeronautical institute for a two-year full-time course if possible. Persons who are employed and have limited time for training can attend the specialized aviation courses at local institutes. In most instances the supplementary aviation courses will consist of aviation mathematics, aviation science, and other related subjects. Courses in engine or airplane repair will not be taught as separate courses unless students are taking supplementary work at the central aeronautical institute.

# Aviation Instruction in the High Schools of Washington, D. C.

C. W. HOLMES
*Assistant Superintendent of Schools, Washington, D. C.*

SINCE BEFORE Pearl Harbor, the District of Columbia high schools have been interested in making the study of aviation an interesting and functional subject for both boys and girls. A conference of representative U. S. Office of Education and Civil Aeronautics Administration officials and members of the teaching staff of the high schools, together with interested persons affiliated with the flight industry, met early in January, 1942, to prepare a tentative course of study in aviation, one semester in length. The course was primarily for senior-class students who were to have had at least intermediate algebra and physics before enrolling or who were to take physics concurrently with aviation. Experience with the tentative course soon showed the need for its extension into a full-year course. Three members of the teaching staff plus a major in the air force collaborated in the writing of a suitable text to give full meaning to the units constituting the course.

A study of the results of tests administered in May, 1944, throughout the country by the Civil Aeronautics Administration led the District of Columbia high schools to remove all prerequisite requirements for admission to the course. Interest in aviation and ordinary scholarship was set as the basis for entrance into the course.

No flight instruction has been required at any time, though at least one of the teachers has taken many of her students on flights in her own plane. This, however, was always done with the written consent of the parents of those students.

Desiring to take account of stock in an evaluation of the course in aviation, the high schools again held a conference lasting two days, late in September, 1944, in which Office of Education and Civil Aeronautics Administration representatives, together with those from the Civil Air Patrol, again joined with the school personnel—administrative officers, heads of departments, and aviation teachers—to review the existing course and to make suggestions for its modernization and general improvement. Following is a preliminary restatement of the aim of the course, to be re-studied by the conferees as the course develops.

## AVIATION COURSE FOR THE SENIOR HIGH SCHOOLS

### *Aim*

The aim of the course is to provide general information on the whole field of aviation. Only incidentally is the program concerned with either guidance or vocational training. The individual who takes the course should at its conclusion be informed generally on the following phases of aviation:

*General*

1. The student should be familiar with the development of aviation from its beginning to its present position of importance in national and international affairs, both as a means of transportation of persons and goods and as an offensive and defensive weapon.

2. The student should be familiar with aviation terms so that he understands what he reads in newspapers, magazines, and books referring to aviation.

3. It is assumed that the student, at the conclusion of the course, will be acquainted with commercial and private air-transportation-organization operation.

4. The student should be familiar at the conclusion of the course with the programs of engineering research carried on by many universities, by engineering divisions of aircraft-manufacturing organizations, and by public and private agencies, and with the production of aircraft by modern methods.

*Specific*

1. The student, on completion of the course, should be familiar with the principles of aerodynamics, navigation, meteorology, airplane powerplants, aircraft maintenance, and civil air regulations.

2. The student should be familiar with the career opportunities in the field of aviation and should know the requirements for aviation licenses.

REVISION

The conferees will meet again to make final recommendations, after which the completed revision will be sent to the District of Columbia Board of Education, together with the course of study in its revised form, for its approval and for adoption. Not many changes are recommended in the course of study. Time allotments are tentatively shifted and will have to be tried out beginning with the second semester in February, 1945, before they can be definitely set. The revised course, in tentative form, follows:

THE COURSE OF STUDY IN AVIATION

I. INTRODUCTION—*Opportunities in Aviation (approximately 2 weeks)*
   - A. Why Fly?
   - B. Aviation in the Services
     1. Army Wings
     2. Navy Wings
   - C. Flying for Business and Pleasure
     1. Commercial Aviation
     2. Private Flying
     3. Civil Aeronautics Administration

II. WHAT MAKES A PLANE FLY?—*Aerodynamics* (approximately 6 weeks)
   - A. The Nomenclature of Flying
   - B. Basic Laws of Physics Which Affect Flight
     1. The Ocean of Air in Which We Live
     2. Laws of Motion
     3. Airflow About a Wing
   - C. Control of Forces Affecting Flight
     1. Lift and Drag
     2. Selection of Airfoils

3. Parasite Resistance
4. The Propeller
5. Stability and Maneuverability
6. Performance of an Airplane in Flight
7. Dynamic Loads

III. HOW ARE PLANES BUILT?—*Aircraft Structures* (approximately 5 weeks)

A. Airplanes
1. Types of Airplanes
2. Stresses Acting on an Aircraft
3. Materials
4. Aircraft Structure Units
5. Joining, Fastening, and Safetying
6. Manufacturing
7. Testing and Inspecting
8. Care, Maintenance, and Service Operation
9. Research

B. Parachutes
1. Development 2. Types 3. Maintenance and Operation

IV. HOW ARE PLANES POWERED?—*Engines and Propellers* (approximately 5 weeks)

A. Engines
1. Importance of Engines to Aviation
2. Classification of Engines
3. Function of the Aircraft Engine
4. Aims of Good Design
5. Types of Aircraft Engines
6. Principles of Operation
7. Horsepower
8. Engine Instruments
9. Number and Location of Engines
10. Care, Maintenance, and Service Operation

B. Propellers
1. Materials
2. Design
3. Care, Maintenance, and Service Operation

V. HOW DOES THE CHANGING AIR AFFECT FLIGHT?—*Meteorology* (approximately 10 weeks)

A. Weather and the Pilot
B. The Atmosphere
1. Exploration 2. Composition 3. Weather Elements
C. Air Masses and Fronts
1. Air-Mass Weather 2. Frontal Weather
D. Weather Reports
1. Observation and Collection
2. Distribution
3. Airways Communications
E. Safety in Flying
1. Clouds 3. Ice 5. High Winds
2. Fog 4. Thunderstorms 6. Thin Air
F. Flight Planning

VI. HOW DO WE FLY FROM ONE PLACE TO ANOTHER?—*Air Navigation* (approximately 8 weeks)

A. Problems of Air Navigation B. The Earth

C. Chart Reading
   1. Projection and Scales
   2. Topographic Information
   3. Aeronautical Data
   4. Airports
   5. Flight Check

D. Pilotage
   1. Procedure
   2. Flying a Range
   3. Distance
   4. Time Intervals

E. Dead Reckoning
   1. Advantages
   2. Basic Problems
   3. Special Problems

F. Aids to Navigation
   1. Radio
   2. Instruments
   3. Markers

VII. WHAT ARE THE CIVIL AIR REGULATIONS APPLICABLE TO CONTACT FLIGHT AND TO THE QUALIFICATIONS OF PERSONNEL?—*Requirements* (remaining time available)

A. Legal Requirements for Ownership and Operation of Aircraft

B. Required Inspections

NOTE: The following flight and navigation instruments will be studied whenever and wherever applicable: Flight Instruments—altimeter, air-speed indicator, turn-and-bank indicator, rate-of-climb indicator, artificial horizon; Navigation Instruments—clock, magnetic compass, directional gyroscope, drift sight.

POINTS OF EMPHASIS

Too much emphasis will not be placed on Civil Air Regulations in the classrooms because the conferees were generally in agreement that they can be easily mastered by interested students in out-of-school study, with the occasional guidance and suggestions of the instructors.

Special attention is invited to the fact that the District of Columbia high schools are not planning to teach their students to become pilots but rather to use the airplane as a scientific laboratory in which each student enrolled in the aviation course may get flight *experience*. To this end a small committee consisting of a high-school principal, two heads of departments, and two teachers of aviation are investigating the desirability of the Board of Education's contracting with a nearby flight school or airport for instruction "in the laboratory" or purchasing one or more airplanes and employing additional teachers who will be in charge of the planes and the instruction given in them.

Students desiring to take the examinations given by the Civil Aeronautics Administration for licenses as private pilots will be helped to study for those examinations, but the course is not organized *per se* to qualify them to pass such tests; it is believed, however, that the instruction and the ground covered will enable any earnest-minded student to pass the examinations if he is given the special attention of his instructor that is planned for students with that goal in mind.

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Sickels, D. J. *Riding the Air.* Illus. by B. J. Harris, New York: American Book Co. 1943. 144 pp. 84c

B. *Readings for the Upper Elementary Group*

Arey, Charles K. *The Airport,* New York: Macmillan Co. 1943. 35 pp. 40c; also *Elementary School Science For The Air Age.* 145 pp. 72c

Dunn, Marshall, and Morisett, L. M. *Wings For America.* Illus. Yonkers-on-Hudson: World Book Co. 1943. 244 pp. $1.00

Floherty, J. J. *Aviation From Shop to Sky.* Illus. with photographs. Philadelphia: Lippincott and Co. 1941. 215 pp. $2.00

Gann, E. K. *Getting Them Into The Blue.* Illus. New York: Crowell. 1942. 153 pp. $2.00

Grimm, D. H. *Junior Aviation Science.* Illus. by Clayton Knight and Erick Sloane. New York: Noble. 1942. 111 pp. 90c

Renner, George T. and Bauer, Hubert A. *The Air We Live In.* New York: Macmillan Co. 47 pp. 36c

Zim, H. S. *Man In The Air.* Effects of flying on the human body. Illus. with drawings by James MacDonald and with photographs. New York: Harcourt, Brace and Co. 1943. 332 pp. $3.00

For teachers: *The Age of Wings.* Denver Public Schools, Denver, Colo.

### IV. SOCIAL STUDIES

A. *Readings for the Intermediate Group*

Carroll, Ruth and Latrobe. *Flight Of The Silver Bird.* Illus. New York: Messner. 1939. $2.00

Phillips, J. E. *On The Airways.* Evanston: Row Peterson. 1942. 32c

Rifkin, Lillian, and Cooke, D. C. *When I Grow Up I'll Be a Flier.* Illus. with photographs. New York: Lothrop. 1942. 40 pp. $1.25

Washburn, Stanley, Jr. *Bamboo To Bombers.* Illus. by E. A. Wilson. Chicago: Albert Whitman. 1941. 42 pp. $1.00

B. *Reading for the Upper Elementary Group*

Adams, Jean, and Kimball, Margaret. *Heroines of The Sky.* New York: Doubleday. 1943. $2.50

Brier, H. M. *Skycruiser.* New York: Random House. 1939. $2.00, also *Sky Freighter.* 1942. $2.00

Fraser, Chelsea. *Famous American Flyers.* New York: Crowell. 1941. $2.50

Hagedorn, Hermann. *Sunward I've Climbed.* New York: Macmillan. 1943. 166 pp. $1.75

Heflin, Alma. *Adventure Was The Compass.* Boston: Little, Brown, and Co. 1942. $2.75

Leyson, B. W. *Aeronautical Occupations.* Illus. New rev. ed. New York: Dutton. 1942. 187 pp. $2.00

Peckham, Betty. *Sky Hostess.* New York: Thomas Nelson. 1941. $1.75

Yates, R. F. *Boy's Book Of Communications.* Illus. with photographs and diagrams. New York: Harper, 1942. 144 pp. $2.00

*Bibliography Of Aviation Education Materials.* New York: Macmillan Co. 139 pp. 88c. Listings of books, periodicals, films, maps, and charts, as well as information on sources of free or inexpensive materials, many of which are suitable for use by elementary-school pupils.

## Secondary Schools

### I. ENGLISH

A. *Junior High School*

Benet, William R. *With Wings As Eagles.* New York: Dodd, Mead, and Co. 1940. 148 pp. $2.00

Byrd, Richard E. *Skyward.* New York: Putnam Co. 1928. 359 pp. $3.50, Blue Ribbon Books, 1937. $1.49

Cohen, Rose N. *Flying High.* Anthology. New York: Macmillan Co. 1942. 334 pp. 76c

Fraser, Chelsea C. *Heroes Of The Air.* New York: Crowell. 1942. 888 pp. $2.50

Hager, Alice R. *Wings Over The Americas.* New York: Macmillan Co. 1940. 162 pp. $2.50

Herzberg, M. J., Paine, M. P., and Works, A. M. *Happy Landings.* Boston: Houghton-Mifflin Co. 1943. 398 pp. $1.48

McDonald, Eugene F. *Youth Must Fly.* New York: Harper. 1942. 221 pp. $2.50

O'Malley, Patricia. *War Wings For Carol.* New York: Dodd, Mead. 1943. $2.00; also *Wings For Carol,* New York: Greystone Press. 1941. 320 pp. $2.00

Tunis, John R. *Million-Miller.* New York: Messner. 1942. 253 pp. $2.50

B. *Senior High School*

Benet, William R. *With Wings As Eagles.* New York: Dodd, Mead. 1940. 148 pp. $2.00

Cooke, D. C. *The Model Plane Annual: 1944.* New York 3: Robert McBride. 1944. 224 pp. $2.75

Cross, E. A. *Wings For You.* Anthology. New York: Macmillan Co. 1942. 366 pp. 76c

Donohue, Arthur G. *Tally Ho!* New York: Macmillan Co. 1941. 190 pp. $2.50

Gaer, Joseph. *Everybody's Weather.* Philadelphia: Lippincott Co. 1944. 96 pp. $2.00

Innes, Hammond. *Attack Alarm.* New York: Macmillan Co. 1942. 287 pp. $2.50

Lay, Beirne, Jr. *I Wanted Wings.* New York: Harper: 1943. 355 pp. $1.12

Lindbergh, Anne Morrow. *Listen! The Wind.* New York: Harcourt, Brace and Co. 1938. 275 pp. $2.50

Miller, Blaine and Dupont. *Gob Wakefield.* New York: Dodd, Mead, 1941. 285 pp. $2.00

Paust, Gilbert. *Here's How to Fly.* New York 16: Essential Books. 1944. 264 pp.

Rodman, Selden. *The Poetry Of Flight.* Anthology. New York: Duell, Sloan, and Pearce. 1941. 190 pp. $2.50

Saint Exupery, Antoine de. *Flight To Arras.* New York: Reynal and Hitchcock. 1942. 255 pp. $2.75; also *Wind, Sand, and Stars.* 1939. 308 pp. $2.75

**II. SOCIAL STUDIES**

Arey, Charles K. *The Airport.* New York: Macmillan Co. 1943. 35 pp. 40c

Bartlett, Hall. *Social Studies For The Air Age.* New York: Macmillan Co. 1942. 180 pp. 60c

Frederick, John H. *Commercial Air Transportation.* Chicago: Richard D. Irwin, Inc. 1942. 493 pp. $4.50

Freudenthal, Elisbeth E. *The Aviation Business.* New York: The Vanguard Press. 1940. 342 pp. $3.00

Heinmuller, John P. V. *Man's Fight to Fly.* New York: Funk & Wagnalls. 1944. 366 pp. $6.00

Hodgins, Eric, and Magoun, F. Alexander. *Sky High.* Boston: Little, Brown, and Co. 1935. 414 pp. $2.75

Johnson, S. Paul. *Horizons Unlimited.* New York: Duell, Sloan, and Pearce. 1941. 354 pp. $3.75

Keempffert, Waldemar. *The Airplane and Tomorrow's World.* No. 78. New York: Public Affairs Committee. 1943

*Maps and How to Understand Them.* San Diego, Calif.: Consolidated Vultee Aircraft Corporation. 1943

Renner, George T. *Human Geography In The Air Age.* New York: Macmillan Co. 1942. 252 pp. 64c

*What Your Town Needs.* Lock Haven, Pa.: Piper Aircraft Corporation. Free

**III. GEOGRAPHY**

Baer, Marian E. *Rain or Shine,* The Story of Weather. New York: Farrar and Rinehart. 1940. 292 pp. **$2.00**

Bauer, H. A. *Globes, Maps, and Skyways.* New York: Macmillan Co. 1942. 84 pp. 40c

Gaer, Joseph. *Everybody's Weather.* Philadelphia: Lippencott Co. 1944. 96 pp. $2.00

*Global Geography.* Columbus, Ohio: Harrison Publishing Co. 1944. 48 pp.

Halpine, Charles G. *A Pilot's Meteorology.* New York: Van Nostrand. 1941. 220 pp. $2.50

Packard, Overton and Wood. *Our Air-Age World.* New York: Macmillan Co. 1944. 838 pp.

Parker, Bertha. *Ask The Weather Man; Clouds, Rain, and Snow; Our Ocean of Air; Seeds and Seed Travel; The Ways Of Weather.* Evanston, Ill.: Row, Peterson and Co. 1941. 36 pp. each. 28c each

Raisz, E., *Atlas of Global Geography.* New York: Harper and Bros. 1944. 63 p. $3.50

Renner, George T. *Human Geography In The Air Age.* New York: Macmillan Co. 1942. 252 pp. 64c

Renner, George T., and Bauer, Hubert A. *The Air We Live In.* New York: Macmillan Co. 1942. 56 pp. 36c

Sloane, Eric. *Clouds, Air, and Wind.* New York: Devin-Adair Co. 1941. 76 pp. $3.00

U. S. Navy Bureau of Aeronautics, Training Division, *Introduction To Earth.* New York: McGraw-Hill Co. 1943. 77 pp. **$1.00**

**IV. MATHEMATICS**

Buchan, A. F., Brothwick, R. and Wadden, William R. *Aviation Mathematics.* Boston: Houghton, Mifflin Co. 1942. 132 pp. **$1.25**

Downer, Alvin E. *Practical Mathematics of Aviation,* New York: Pitman Publishing Co. 1939. 110 pp. **$1.00**

Lyon, T. C. *Practical Air Navigation,* Civil Aeronautics Bulletin No. 24. Washington, D. C.: U. S. Government Printing Office. 1940. 245 pp. $1.00

Naidich, James. *Mathematics of Flight.* New York: McGraw-Hill Co. 1943. 409 pp. $2.20

Osteyee, George. *Mathematics In Aviation.* New York: Macmillan. 1942. 198 pp. 64c

Thompson, W. H. and Aiken, M. L. *1000 Pre-Flight Problems.* New York: Harper. 1943. 160 pp. 88c

U. S. Navy, Bureau of Aeronautics, Training Division, *Mathematics For Pilots.* New York: McGraw-Hill. 1943 157 pp. 75c

V. INDUSTRIAL ARTS

Air Youth of America. *Building and Flying Model Airplanes.* New York: Appleton-Century. 1941. 246 pp. $2.00

Brown, Willis C. *Airplane Models and Aviation.* Boston: Heath. 1942. 43 pp. 48c

Cook, Charles H. *Model Airplane Design and Theory of Flight.* New York: McBride and Co.

Cooke, D. C. *The Model Plane Annual.* New York: McBride and Co. 1944. 224 pp. $2.75

Grant, Charles H. *Model Airplane Design and Theory of Flight.* New York: Jay Pub. Co. 1941. 512 pp. $3.75

Civil Aeronautics Administration. *Sources of Information on Model Airplanes, Gliders, and Kites.* Washington, D. C.: The Administration. 1942. 7 pp. free

Wilber, Gordon O. and Neuthardt, Emerson E. *Aeronautics in The Industrial Arts Program.* New York: Macmillan Co. 1942. 264 pp. 92c

Winter, William J. *The Model Aircraft Handbook.* New York: J. Y. Crowell. 1941. 292 pp. $2.00

Zier, Avrum. *Aerodynamics For Model Aircraft.* New York: Dodd, Mead, and Co. 1942. 259 pp. $3.00

V. BIOLOGY

Aymar, Gordon C. *Bird Flight.* New York: Dodd, Mead and Co. 1935. 234 pp. $4.00

Fitzpatrick, F. L. and Stiles, K. A. *The Biology Of Flight.* New York: Macmillan Co. 1942. 180 pp. 64c; also a teacher's manual, 27 pp. 20c

Ray, Ermin L. and Washburn, Stanley L. *Are You Fit To Be A Pilot!* New York: Funk. and Wagnalls. 1941. 61 pp. $1.75

U. S. Navy, Bureau of Aeronautics, Training Division. *The Effects of Flight* (Part II, *Principles of Flying*) New York: McGraw-Hill. 1943. 120 pp. 60c

VII. PHYSICS

Aviation Education Research Group, *Science of Pre-Flight Aeronautics For High Schools.* New York: Macmillan Co. 1942. 868 pp. $1.32

Eddy, Paul, *Applications Of High-School Science And Mathematics In Aeronautics.* Tallahassee, Florida: State Department of Education. 1942. 50 pp.

Grant, Charles H. *Model Airplane Design and Theory Of Flight.* New York: Jay Pub. Co. 1941. 512 pp. $3.75

Hume, Duncan C. M. *Elementary Aerodynamics.* New York: Pitman. 1941. 136 pp. $1.50

Jones, Bradley. *Elements of Practical Aerodynamics.* New York: John Wiley and Sons. 1942. 436 pp. $3.75

Menzer, J. G., Peake, M. M., and Leps, J. M. *Physical Science In The Air Age.* New York: Macmillan Co. 1942. 210 pp. 80c

U. S. Navy, Bureau of Aeronautics, Training Division, *Physics Manual For Pilots.* New York: McGraw-Hill. 1943. 229 pp. 90c

VIII. GENERAL TEXTS

A. *Major References*

Aviation Education Research Group, Teachers College, Columbia University. *Science*

*Of Pre-Flight Aeronautics For High Schools.* New York: Macmillan Co. 1943. 868 pp. $1.32. Teachers' Manual, 1942, 248 pp. 80c

Aviation Education Research Group, Teachers College, University of Nebraska. *Elements of Pre-Flight Aeronautics For High Schools.* New York: Macmillan Co. 1943. 555 pp. 96c. Teachers' Manual, 1942. 113 pp. 72c.

Brooks, Bernard. *How To Fly an Aeroplane.* Toronto, Canada: Aeroplane Photo Supply, Box 195. $1.50

Hamburg, Merrill, and Tweney, George H. *American Student Flyer.* New York: Putnam Pub. Co. 1942. 635 pp. $1.50

*The Illustrod Aviation Encyclopedia.* Toronto, Canada: Aeroplane Photo Supply, Box 195. $1.39

Pope, Francis, and Otis, Arthur S. *Elements of Aeronautics,* Yonkers-on-Hudson: World Book Co. 1941. 660 pp. $2.00

Pope, Francis, and Otis, Arthur S. *The Airplane Power Plant,* Yonkers-on-Hudson: World Book Co. 1944. 188 pp.

Robinson, Pearle T. and others. *Before You Fly.* New York: Henry Holt and Co. 1943. 560 pp. $2.00

Shields, Bert A. *Air Pilot Training.* New York: McGraw-Hill Co. 1943. 602 pp. $3.50

Wilson, G. E. *How to Identify Aircraft.* Toronto, Canada: Aeroplane Photo Supply, Box 195. $1.25

B. *Supplementary References*

*Aerosphere's Modern Aircraft.* New York: Aerosphere, Inc. 1943. $7.50

*Airplane Power.* General Motors, Room 11-230, Detroit, Michigan

Barr, E. U. *Flying Men and Medicine.* New York: Funk and Wagnalls. 1943. $2.50

Civil Aeronautics Administration. *Pilot Certificates.* Civil Air Regulations. Part 20. February 15, 1944. Washington, D. C.: Government Printing Office. 1944. 10c

Civil Aeronautics Administration. *Air Traffic Rules.* Civil Air Regulations, Part 60, August 15, 1944. Washington, D. C.: Government Printing Office, 1944. 10c

Civil Aeronautics Bulletin No. 25. *Meteorology For Pilots* by B. G. Haynes. Washington, D. C.: Government Printing Office. 2nd. ed. 1943. 75c

Civil Aeronautics Administration. *Fundamentals of Elementary Flight Maneuvers.* Civil Aeronautics Bulletin No. 32, February, 1943. Washington, D. C.: Government Printing Office. 1943. 20c

*Digest of Civil Air Regulations.* American Education Press, Columbus, Ohio. 1944 (Supplement of Current Aviation)

Gillmer, Thomas C. and Nietsch, Herman E. *Simplified Theory of Flight.* New York: D. Van Nostrand Co. 1941. 162 pp. $2.00

Halpine, Charles G. *A Pilot's Meteorology.* New York: D. Van Nostrand Co. 1941. 220 pp. $2.50

Humphrey, S. W. J. *Ways Of The Weather.* Lancaster, Penna.: J. Cattell Press. 1943. 391 pp. $4.00

Jordanoff, Assen. *Your Wings.* Rev. Ed. New York: Funk and Wagnalls. 1942. 294 pp. $3.00

Lamb, Scott G. *Air Navigation For Beginners.* New York: N. W. Henley Pub. Co. 1943

Michie, Allen A. *Keep the Peace Through Airpower.* New York: Henry Holt and Co. 1944. $2.00

Shields, Bert A. *Principles Of Air Navigation.* New York: McGraw-Hill Co. 1943; also *Principles Of Flight.* 1942. 363 pp. $1.98

*Summary of U. S. Civil Air Regulations,* Third edition, Kansas City, Mo.: Mayday Flight Co. 1943. 50 pp. 50c

U. S. Navy, Bureau of Aeronautics, Training Division, *Principles Of Flying.* New York:

McGraw-Hill Co. 1943. 338 pp. $1.50; also *Operation of Aircraft Engines*. 1943. 206 pp. 90c; also *Aerology For Pilots*. 1943. 107 pp. $1.00

U. S. Weather Bureau. *Cloud Forms*. Washington, D. C.: Department of Commerce. 1941

Vetter, E. G. *Visibility Unlimited*. New York: William Morrow and Co. 1942. 346 pp. $4.00

Zim, Herbert S. *Air Navigation*. New York: Harcourt, Brace, and Co. 1943. $3.00

### IX. OCCUPATIONAL INFORMATION

*About That Job With United Air Lines*. United Air Lines

*Aviation Cadet Training For Army Air Forces*. U. S. Army

*A Guide To Aeronautical Occupations*. Boeing School of Aeronautics, Oakland, Calif.

*Jobs In Naval Aviation*. Information chart, U. S. Navy

*Opportunities For Youth In Air Transportation*. Air-Age Research, 100 East 42nd Street, New York

Leyson, Burr W. *Aeronautical Occupations*. New York: E. P. Dutton and Co. 1941. $2.00

### X. PERIODICALS

*Aero Digest*, Aeronautical Digest Pub. Corp., 515 Madison Avenue, New York City, monthly, $3.00 a year

*AFTAD Bulletin*. Headquarters of the Army Air Forces in your local state capitol. Editorial address: Chief AFTAD. One Park Ave., New York City 16. Published intermittantly.

*Air News*, Air News Publishing Corp., 515 Madison Avenue, New York City, monthly, $3.00 a year.

*Air Progress*. Street and Smith Publications, Inc., 79 Seventh Avenue, New York City, monthly, $2.50 a year

*Air Trails*. Street and Smith, 79 Seventh Avenue, New York, monthly. $1.75 a year.

*American Aviation*. American Aviation Associates, Inc. 1317 F. Street, N. W., Washington, D. C., semi-monthly, $4.00 a year

*Aviation*. McGraw-Hill Pub. Co., 330 W. 43rd Street, New York, monthly, $3.00 a year.

*Civil Aeronautics Journal*. Government Printing Office, Washington, D. C. monthly, 50c a year.

*Contact*. Airlines Terminal Building, 80 E. 42nd St. New York City, monthly, 15c; $2.00 a year

*Current Aviation*. American Education Press, Inc., 400 South Front St., Columbus, Ohio, and 580 Fifth Avenue, New York. Weekly during school semester, 70c per student in clubs of 30 or more, 80c per student in clubs of 10 to 20, no orders for less than 5 copies.

*Flight*. 20 Vesey St., New York, monthly 35c

*Flying*. Ziff-Davis Publishing Co., 540 N. Michigan Ave., Chicago, Ill., monthly 35c

*Model Airplane News*. Air Age Inc., Mt. Morris, Ill., monthly, $2.00 a year

*National Aeronautics* (including *Air Youth Horizons*). American Aeronautics Association, 1317 F St., N. W., Washington 6, D. C. monthly, $3.00 a year

*Model Aircraft Magazine*. Penn. Publications, Inc., East Stroudsburg, Pa. Order from 110 West 42nd Street, New York, monthly, $1.50 a year

*Skyways*. 444 Madison Ave., New York, monthly 25c

### XI. MAPS, CHARTS, AND GLOBES

*Butterfly World Map*. Chicago: Denoyer-Geppert. Desk outline maps: 11" x 16", 85c per 50; 16" x 22", $1.75 per 50

*Globe on Universal Globe Stand*. New York: Rand McNally and Co. $21.00

Johnson, William E. *The Earth*. (Manual to accompany the Rand McNally Universal Globe) New York: Rand McNally and Co. 1938. 32 pp. $1.00

*Polar Aeronautical World*. Chicago: A. J. Nystrom and Co. 1942. 64" x 45", $8.25

*Polar Projection Work Map.* New York: Rand McNally and Co. 11" x 11½". 5c each, $3.00 per 100

*Political Map Of The World,* on the "Casson Projection". New York: The University Map Co.

Renner, George T., ed. *World Map For The Air Age.* New York: Rand McNally and Co. 1942. 44" square. $6.00

*Sectional Aeronautical Charts.* Washington, D. C.: U. S. Coast and Geodetic Survey. These are restricted for military reasons, however, a special educational sheet containing five duplicate charts of the Des Moines area is available at 25c per sheet; and another educational sheet containing four sectional and four regional charts of the Seattle area is available at 25c per sheet.

U. S. Weather Bureau. *Cloud Forms.* Washington, D. C.: Government Printing Office, 1926. 5c

*Victory Globe.* New York: Rand McNally and Co. 9" in diameter. $1.95

*The Denoyer-Geppert Meteorology Series.* Chicago: Denoyer-Geppert Co. Four charts in color, each 44" x 58", 10 plain wood rollers, top and bottom, $6.25; 12 spring rollers and board, dust-proof, $8.00; folded styles (-ID, -IL, or -VH). $8.00. (Manual free)

*Polar Air Age World.* Chicago: Denoyer-Geppert Co. Azimuthal Equal Area projection, 44" x 58" (400 miles to inch). Land Areas colored to show Economic Activities as (1) Agriculture, (2) Grazing, (3) Forests, and (4) Unproductive, 10 plain wood rollers, top and bottom, $6.25; 12 spring rollers and board, dustproof, $8.00; folded styles (-ID, -IL, or -VH), $8.00

## XII. SUPPLEMENTARY MATERIALS

The following agencies have free or inexpensive materials available to teachers:

A. *Airlines*

*All American Aviation, Inc.,* 200 West Ninth Street, Wilmington, Del.
A booklet, *The Air Pick-Up, The Airway To Everywhere,* describes the pick-up and delivery of mail and express while in flight by airplane service, acting as a feeder to the main air routes.

*American Airlines, Inc., Air-Age Education Research.* 100 East 42nd St., New York City. Booklets: *Into The Air Age. Opportunities For Youth In Air Transportation, Aviation Maintenance, Make Friends With Mexico.* Six charts in color with accompanying pamphlets: *The Air Ocean, Meteorology, The Airplane And How It Flies, Airline Operation, Air Communication,* and *Air Navigation.* Also air map, air world map, United States Air Transport System Map, and full-color lithograph prints.

*Braniff Airways, Inc.,* Love Field, Dallas, Texas
Booklets: *Sky Hikin', Portraits Of An Airplane,* also route map, folders.

*Chicago and Southern Airlines, Inc.,* Municipal Airport, Memphis, Tenn.
Airway map, colored pictures, booklet on Douglas Transport Planes, schedules, pamphlets, *Early History Of Chicago and Southern Air Lines, Little Known Facts, Perspectives On Commercial Air Transport, Selling Victory.*

*Colonial Airways, Inc.,* 630 Fifth Avenue, New York City
Maps, folders, booklets, time-table.

*Continental Air Lines, Inc.,* Municipal Airport, Denver, Colorado.
Map, time-table, annual report.

*Delta Air Lines,* Public Relations Department, Municipal Airport, Atlanta, Ga.
Map, folders, Booklets: *Delta's Routes Are High In Historical Background, What Does It Take To Be An Airline Pilot, Airline Reservations Department Requires Careful Procedures,* etc.

*Eastern Air Lines,* Eastern Air Lines Building, 10 Rockefeller Plaza, New York City.
Route maps, schedule folders, booklets: *Sky Pictures, Speaking of Operations.*

*Inland Air Lines, Inc.,* P. O. Box 1811, Casper, Wyo.
Folders and any other material available when requests are made.

*Midcontinent Airlines, Inc.*, Fairfax Building, Kansas City, Mo.
Folders and other educational material that might be available.

*National Airlines, Inc.*, Municipal Airport, Jacksonville, Fla.
Route map, time-table, booklet: *You Are Flying In A Lockheed Lodestar*, which includes pictures and seventy questions and answers about planes and how they are flown.

*Northeast Airlines, Inc.*, Commonwealth Airport, East Boston, Mass.
Time-table, booklets, folders.

*Northeast Airlines, Inc.*, St. Paul Municipal Airport, Holman Field, St. Paul, Minn.
Time-table, folders, route map, booklet: *Just Press The Button*, which describes the stewardess' service to passengers.

*Pan American Airways System*, Public Relations Department, Chrysler Building, New York City
Information in regard to the system and the countries it serves.

*Pennsylvania-Central Airline Corp.* Washington National Airport, Washington, D. C.
Maps, folders, time-tables, booklets, colored posters, cards.

*Transcontinental and Western Air, Inc.* 10 Richards Road, Kansas City, Mo.
Maps, time-tables, folders, booklets, colored posters, cards.

*United Air Lines*, William A. Pullin, Regional Traffic Office, Air Lines Terminal, Park Avenue and 42nd Street, New York City
Kits, 25 cents each: Primary Aviation Teaching Kit—for Grades 1-3; Intermediate Aviation Teaching Kit—for Grades 4-6; Junior and Senior High-School Aviation Teaching Kit.
pensive Materials. Primary Grade reading folders—*Mike, The Future Pilot; Mike and Nancy at the Airport.*
*Mike, The Future Pilot, Mike and Nancy at the Airport.*
Booklets, free: *The Story of United Air Lines, The Airplane in Postwar Transportation, Little Known Facts About the Air Transport Industry, How Representative Grade Teachers Are Teaching Aviation.* Miscellaneous pictures, free: Film Strips—free (obtainable from Society for Visual Education, Chicago), *Behind the Scenes of a Coast-to-Coast Flight*, and teachers' manual, *Air Line Opportunities.* Recordings—free to those having 33⅓ RPM reproducing machine—*Air Transportation; Research Engineering; Air Transportation; Airports and Airways; Air Transportation; Some Interesting Aircraft Developments.*

*Western Air Lines*, 510 West 6th Street, Los Angeles, Calif.
Time-table, folders, post cards, booklets.

B. *Manufacturers of Planes*
Write to the Public Relations Departments of these manufacturers for booklets, pictures, and information concerning aircraft occupations, present and future planes.
*Boeing Aircraft Company*, Georgetown Station, Seattle, Wash.
*Chance-Vought Aircraft Corporation*, Stratford, Conn.
*Consolidated-Vultee Aircraft Corporation*, San Diego, Calif.
*Curtiss-Wright Corp.*, Buffalo, N. Y.
*Douglas Aircraft Company, Inc.*, Santa Monica, Calif.
*Hamilton Standard Propeller Co.*, East Hartford, Conn.
*Lockheed Aircraft Corporation*, 1705 Victory Place, Burbank, Calif.
*Northrop Aircraft Inc.*, Northrop Field, Hawthorne, Calif. (Builders of the All-Wing Plane)
*Piper Aircraft Corporation*, Lock Haven, Pa.
Publishes booklets about their planes, also one about airport planning, called *What Your Town Needs.* Also teaching kit, etc.
*Vought-Sikorsky Aircraft*, Bridgeport, Conn. (Builders of the Helicopter)

C. *Other Sources*

*The Aeroplane Photo Collection.* Aeroplane Photo Supply, Box 195, Toronto, Canada. A new periodical which the company will send free to its regular customers *only.* This company also has a large assortment of aeroplane pictures for sale at reduced rates for quantity lots.

*Air Express Division,* Railway Express Agency, 230 Park Avenue, New York City
Booklets: *Commissioned To Keep 'Em Moving, How To Ship By Air Express During War Time,* etc., also Air Express estimator

*Air Transport Association of America,* 1515 Massachusetts Avenue, N. W., Washington, D. C.
Leaflets presenting pertinent aviation topics, also their annual edition of *Little Known Facts About The Air Transport Industry.*

*American Aviation Directory.* American Aviation Association, 1317 F Street, N. W., Washington 4, D. C. Two issues per year. Approximately 600 pp. each. $7.50 per year or $5.00 per single copy.
A comprehensive directory about the entire field of aviation.

*American Aviation Traffic Guide.* American Aviation Associates, 1317 F Street, N. W., Washington 4, D. C. Monthly, $5.00 a year.
Schedules, fares, information, regulations, and airline route maps.

*American Daily Aviation.* American Aviation Association, 1317 F Street, N. W., Washington 4, D. C.
Daily composed of six mimeograph letter-size sheets, by air mail, six days each week. Price, $170 per year or $15 per month. Indexed by month. On-the-minute domestic news pertaining to aviation. Punched for ring-binder filing.

*Civil Aeronautics Administration,* Aviation Education Service, Ref. A-6, Washington, 25, D. C.
Bulletins on latest developments in aviation education, study references, achievement tests, examinations, teacher guides, demonstration material.

*Division of Air Mail Service,* United States Post Office Department, Washington 25, D. C.
Air mail service maps of the United States and the world.

*International Aviation.* American Aviation Association, 1317 F Street, N. W., Washington 4, D. C.
A mimeograph weekly letter-size publication of up-to-the-minute foreign news on aviation of eight to twelve pages per week. Punched for ring-binder filing. Totals about 500 pages per year. Sent first-class mail every Friday evening. $100.00 per year for the service.

*The Official Aviation Guide Company, Inc.,* 608 South Dearborn Street, Chicago, Ill.

*U. S. Office of Education,* Federal Security Agency, Washington, D. C.

*University Airline Schedules,* 139 North Clark Street, Chicago, Ill.

### XIII. FREE LIBRARY SERVICE

The Paul Kollsman library of the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York City
Aims to have copies of all aeronautical books, loans books by mail for one week without charge except for return postage in returning books. Periodicals, reference books, and rare books are not loaned. Borrower must be at least 18 years old, and have references certifying to his responsibility.

XIV. SOUND FILMS AND FILM STRIPS

| *16-mm. Film* | *35-mm. Film Strip* | *Title and Description* | *Sale Price* | *Approx. Rental Cost* | *Producer* |
|---|---|---|---|---|---|
| A. *History of Aviation* | | | | | |
| x | | CONQUEST OF THE AIR. | | $10.00 | Films, Inc. |
| x | | CRADLE OF VICTORY. Shows history of air transport. | | free | Princeton Film Center |
| | x | AIRCRAFT SERIES. Historical, No. 8. | 2.00 | | Society for Visual Education, Inc. |
| | x | MEN AND WINGS. Pilot Training Kit 1, No. 1. | 3.50 | | Jam Handy |
| | x | TODAY'S WINGS. Pilot Training Kit 1, No. 2. | 3.50 | | Jam Handy |
| B. *Structure of Airplanes* | | | | | |
| x | | AIRPLANE STRUCTURES: *Structural Units, Materials and Loads for Which Designed.* Released 1941. (Running time: 8 min.) T. F. 1-211. | | 1.00 | Castle |
| x | | AIRPLANE STRUCTURES: *Wing Construction.* Released 1941. (Running time: 11 min.) T. F. 1-212. | | 1.00 | Castle |
| x | | AIRPLANE STRUCTURES: *Fuselage Construction.* Released 1941. (Running time: 8 min.) T. F. 1-213. | | 1.00 | Castle |
| x | | AIRPLANE STRUCTURES: *Alighting Gear.* Defines alighting gear. Released 1942. (Running time: 10 min.) T. F. 1-215. | | 1.00 | Castle |
| x | | AIRPLANE STRUCTURES: *Manufacturing Methods.* Released 1942. (Running time: 25 min.) T. F. 1-323. | | 2.00 | Castle |
| x | | AIRPLANE STRUCTURES: *Control Surfaces.* (Running time: 7 min). T. F. 1-700. | | | U. S. Army Air Forces, Training Aids Division |
| | x | CHECK AND DOUBLE CHECK. Kit 2, No. 5. | 3.50 | | Jam Handy |
| x | | ALL WORK AND NO PLAY. Shows how some vibration problems are solved by special non-loosening nuts. | | free | The Princeton Film Center |
| x | | BUILDING A BOMBER. | .50 | | Audio-Visual Aids Center |
| | | THE CONSTRUCTION OF A LIGHT | .50 | | Audio-Visual |

| *16-mm. Film* | *35-mm. Film Strip* | *Title and Description* | *Sale Price* | *Approx. Rental Cost* | *Producer* |
|---|---|---|---|---|---|
| x | | AIRPLANE. Describes the Construction of a Piper Cub. | | | Aids Center |
| **C. *Airways and Airports*** | | | | | |
| x | | AERIAL NAVIGATION: *Airways Flying*. Released 1942. (Running time: 38 min.) T. F. 1-328. | | | Castle |
| | x | AIRCRAFT REGULATIONS. Pilot Training, Kit 1, No. 3. | 3.50 | | Jam Handy |
| | | THE PILOT. Pilot Training Kit 1, No. 4. | 3.50 | | Jam Handy |
| | | TRAFFIC. Pilot Training Kit 1, No. 5. | 3.50 | | Jam Handy |
| | | RADIO AND CONTROL. Pilot Training Kit 1, No. 6. | 3.50 | | Jam Handy |
| | | AIRWAY AIDS. Pilot Training Kit 3, No. 6. | 3.50 | | Jam Handy |
| **D. *Civil Air Regulations*** | | | | | |
| x | | AERIAL NAVIGATION: *Airways Flying*. Released 1942. (Running time: 38 min.) T. F. 1-328. | | | Castle |
| **E. *Communications*** | | | | | |
| x | | AERIAL NAVIGATION: *Radio Aids*. Released 1942. (Running time: 30 min.) T. F. 1-327. | 25.00 | 2.00 | Castle |
| | x | RADIO AND CONTROL. Pilot Training Kit 1, No. 6. | 3.50 | | Jam Handy |
| **F. *Meteorology*** | | | | | |
| x | | MODERN WEATHER THEORY: *Primary Circulation*. Released 8-26-40. T. F. 1-133. | | 1.50 | Castle |
| x | | AEROLOGY: *Ice Formation on Aircraft*. (Running time: 47 min). MN-119A. | | | Castle |
| x | | AEROLOGY: *Thunderstorms*. (Running time: 39 min.) MN-1190. | | | Castle |
| | x | THE AIR OCEAN. Pilot Training Kit 3, No. 1. | 3.50 | | Jam Handy |
| | x | AIR MASSES. Pilot Training Kit 3, No. 2. | 3.50 | | Jam Handy |
| | x | WEATHER. Pilot Training Kit 3, No. 3. | 3.50 | | Jam Handy |
| **G. *Theory of Flight*** | | | | | |
| x | | AERODYNAMICS: *Theory of Flight*. | 45.00 | | Encyclopedia Britannica Films, Inc. |
| | | AERODYNAMICS: *Problems of Flight*. | 45.00 | | |

| *16-mm. Film* | *35-mm. Film Strip* | *Title and Description* | *Sale Price* | *Approx. Rental Cost* | *Producer* |
|---|---|---|---|---|---|
| x | | AERODYNAMICS: *Part I. Properties of the Air.* | 35.00 | 2.00 | Bray |
| x | | AERODYNAMICS: *Part II. Lift.* | 35.00 | 2.00 | Bray |
| x | | AERODYNAMICS: *Part III. Air Resistance and Streamlining.* | 35.00 | 2.00 | Bray |
| | x | LIFT AND DRAG. Pilot Training Kit 2, No. 1. | 3.50 | | Jam Handy |
| | x | WING FORCES. Pilot Training Kit 2, No. 2. | 3.50 | | Jam Handy |
| | x | STABILITY. Pilot Training Kit 2, No. 3. | 3.50 | | Jam Handy |
| **H. *The Power Plant*** | | | | | |
| x | | AIRCRAFT ENGINES. *Types, Mechanisms, and Oiling System.* Released 1941. (Running time: 36 min.) T. F. 1-135. | 29.69 | 2.00 | Castle |
| x | | AIRPLANE PROPELLERS. *Principles and Types.* Released 1942. (Running time: 19 min.) T.F. 1-246. | 14.89 | 1.50 | Castle |
| | x | THE AIRPLANE ENGINE. Pilot Training Kit 2, No. 6. | 3.50 | | Jam Handy |
| | x | FUEL AND FEED. Pilot Training Kit 2, No. 7. | 3.50 | | Jam Handy |
| | x | AIRPLANE IGNITION. Pilot Training Kit 2, No. 8. | 3.50 | | Jam Handy |
| | x | ENGINE INSTRUMENTS. Pilot Training Kit 2, No. 9. | 3.50 | | Jam Handy |
| **I. *Air Navigation*** | | | | | |
| x | | AERIAL NAVIGATION: *Maps and the Compass.* Describes the Mercator, Lambert-Conformal, gronomic, and polycopic projections of the earth's surface as used in aerial navigation. Released 1943 (revised) (Running time: 13 min.) T. F. 1-245. | 10.81 | 1.00 | Castle |
| x | | AERIAL NAVIGATION: *Dead Reckoning.* Released 1942. (Running time: 26 min.) T. F. 1-326. | | 2.00 | Castle |
| x | | AERIAL NAVIGATION: *Radio Aids.* Released 1942. (Running time: 30 min.) T. F. 1-327. | 25.01 | 2.00 | Castle |
| x | | AERIAL NAVIGATION: *Airways Flying.* Released 1942 (Running time: 38 min.) T. F. 1-328. | | | Castle |
| x | | CELESTIAL NAVIGATION: *Charts.* Employs animated diagrams and some straight photography to | | 1.50 | Castle |

| *16-mm. Film* | *35-mm. Film Strip* | *Title and Description* | *Sale Price* | *Approx. Rental Cost* | *Producer* |
|---|---|---|---|---|---|
| | | explain the meaning, advantages, and limitations of Mercator, gnomonic, Lambert-Conformal projections. Prepared for use in a carefully organized course in navigation. (Running time: 15 min.) MN-83B. | | | |
| | x | AIR PILOTAGE. Pilot Training Kit 3, No. 4. | 3.50 | | Jam Handy |
| | x | DEAD RECKONING. Pilot Training Kit 3, No. 5. | 3.50 | | Jam Handy |
| | x | AIRWAY AIDS. Pilot Training Kit 3, No. 6. | 3.50 | | Jam Handy |
| | x | FLIGHT INSTRUMENTS. Pilot Training Kit 3, No. 7. | 3.50 | | Jam Handy |
| **J.** ***Flight Maneuvers*** | | | | | |
| x | | FLIGHT MANEUVERS: *Flying the Turn.* (Running time: 11 min.) | | 2.00 | Bray |
| x | | FLIGHT MANEUVERS: *Landing.* (Running time: 11 min.) | | 2.00 | Bray |
| x | | FLIGHT MANEUVERS: *Motions of a Plane.* | | 2.00 | Bray |
| x | | FLIGHT MANEUVERS: *Starting and Taxiing-Taking Off.* | | 2.00 | Bray |
| x | | FLIGHT MANEUVERS: *Aircraft and How They Fly.* | | 2.00 | Bray |
| **K.** ***General Information*** | | | | | |
| x technicolor | | FORTRESS IN THE SKY. Shows engineering, production, and operational activities of the Flying Fortresses. | | free | The Princeton Film Center |
| x | | MISSION ACCOMPLISHED. Story of the Flying Fortress. | | .50 | Audio-Visual Aids Center |
| x | | PARATROOPS: WINGS OF YOUTH. Story of training of RCAF aviators. | | .50 | Audio-Visual Aids Center |
| x | | PBY RECORD BREAKERS. Shows manufacture and performance of the Catalina Bombers. | | free | The Princeton Film Center |
| x technicolor | | THE PT-19 TRAINER. Shows production and basic characteristics. | | free | The Princeton Film Center |
| x | | TARGET FOR TONIGHT. Story of The Wellington Bomber. | | 1.00 | Audio-Visual Aids Center |
| x | | WINNING YOUR WINGS. Story of the training of Army air force pilots. | | .50 | Audio-Visual Aids Center |
| | | BEHIND THE SCENES OF A COAST-TO-COAST FLIGHT. | | free | The Society for Visual Aids |

LIST OF FILM SOURCES

This list of addresses of film sources includes all referred to in this bibliography as well as several others from which the films listed above may be secured.

AUDIO-VISUAL AIDS CENTER, The University of Connecticut, Storrs, Connecticut
BRAY PICTURES CORPORATION, 729 Seventh Avenue, New York, New York
CASTLE FILMS, INC., 30 Rockefeller Plaza, New York 20, New York
ENCYCLOPEDIA BRITANNICA FILMS, INC., 20 North Wacker Drive, Chicago 6, Illinois
FILMS, INC., 330 West 42nd Street, New York, New York
WALTER P. GUTLOHN, INC., 25 West 45th Street, New York, New York
JAM HANDY ORGANIZATION, 2900 East Grand Boulevard, Detroit, Michigan
MUSEUM OF MODERN ART, 11 West 53rd Street, New York, New York
THE PRINCETON FILM CENTER, Princeton, New Jersey
SOCIETY FOR VISUAL EDUCATION, 100 East Ohio Street, Chicago, Illinois
UNITED STATES ARMY AIR FORCES, Training Aids Division, 1 Park Avenue, New York 1, New York
YMCA MOTION PICTURE BUREAU, 347 Madison Avenue, New York, New York

# Appendix

THE AVIATION programs outlined and discussed in the fore part of this publication were each developed by a special committee or committees. The membership of these committees was composed of outstanding school people and others within the state interested in air education. Each of these state committees had assistance from general consultants from outside the state. The list which follows indicates the membership of the various committees within the six states whose programs are reported in this publication.

In some instances the programs, as it will be noted by the committee make-up, were made up of a single committee. In other instances, sub-committees were appointed whose attention was devoted to particular education levels of the school program. As for example, the Wisconsin report was prepared by one general over-all committee, while the Illinois report was prepared by a general committee with the aid of special committees in each of the following areas: The Small Secondary School, The Large Secondary School, and Industrial Art and Vocational Courses in Secondary Schools. Following is the personnel of the committee or committees within each of the states represented who were responsible for the development of the program within their state.

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HARRY E. MERRITT, Supervisor of Secondary Schools, Dept. of Public Instruction, Madison
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RALPH HAEFNER, Educational Consultant, Aviation Education Service, Civil Aeronautics Administration, Washington, D. C.
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ELIZABETH WARNOCK, Aeronautics Instructor, School of Education, University of Pittsburgh and Pittsburgh Public Schools, Pittsburgh (Author of Conference Report)
CHARLES F. ZINN, Chief, Industrial Education, Department of Public Instruction, Harrisburg (Chairman for Industrial Arts and Vocational Education)

# News Notes

FM Broadcasting—WBEZ, the FM station owned and operated by the Radio Council of the Chicago Public Schools has returned to the air with a schedule of broadcasts designed for general and classroom listening. The station operates from 9:30 a. m. to 3:15 p. m. each school day, and carries as part of the daily schedule programs from four networks, news reports, and a group of thirteen programs especially written to supplement the courses of study in the elementary and high schools of Chicago. For the eighth consecutive year, core of school broadcasts will also be released over stations WIND and WJJD, at which time transcriptions will be made of them for release at different times throughout the day on WBEZ.

Twice each week special bulletins from the Superintendent's office are presented. From 12:00 noon to 1:00 p.m. when schools are closed, special news and feature programs are presented for listening teachers. More than 20,000 children, in 5800 classrooms of 403 Chicago schools listen to the radio during an average week of the school year. Handbooks for teachers guidance in the use of radio are prepared and distributed to every classroom using programs. 20,000 such handbooks are distributed twice a school year. So that teachers may know what is available for classroom listening, the Radio Council prepares a weekly program bulletin which lists all WBEZ broadcasts as well as the school-time programs of other stations and networks. FM equipped schools, of which there are now about 125, receive a special bulletin each week, in addition to the standard program bulletin.

Beauty Spots of America—The Kime Kolor Pictures, 1823 East Morada Place of Altadena, California, has recently announced a group of 528 Kodachromes (size 2" by 2") for use in schools and libraries. These superb Kodachrome transparencies comprise a rich variety of topics to make vivid and helpful the teaching of the United States, Canada, and Hawaii. Beautiful and historic spots become real as they are projected on the screen. The material for research on these well-known subjects may be obtained from the company at 50 cents each in readymounts. The company also has 800 similarly mounted films on Latin America.

Education After the War—Forseeing a college and university enrollment of 2,000,000 in this country by 1948, as compared with 750,000 this year and a peacetime peak of 1,500,000, Ernest C. Miller, president of the American Association of Collegiate Registrars, called for an overhauling of college-entrance machinery to meet the demands of new students. He states: "War veterans will take the 'business of education' seriously." After the war we will be keeping records for a larger number and more mature group of students. The registrar may find that many of the mature students will not be interested in course credits and degrees, and that such students will be rather indifferent toward the ritual, symbolism, and stereotypes that we have built up in higher education. The registrar coming within reach of such wholesome influences may wish to abandon the adding-machine methods. Placement tests will have to substitute for high-school credits, especially for veterans who will have studied under the military program. Also, each incoming student will have to be treated individually."

Curriculum Digest—The San Diego City School system of California, through the superintendent, publishes an interesting eight-page paper on the curriculum of the schools. It is the work of the Central Curriculum Council and discusses recent developments as well as reviews of the most recent books pertaining to curriculum. The supplement to the September, 1944, issue presents a diagram of the functional organization of the Curriculum Council as well as a diagram of the inter-relationships of the school staff to the Board of Education and the people of San Diego.

# ATTENTION SCHOOLS

## *Enroll now in the National Association of Student Councils*

**The National Association of Student Councils**
**of the**
**National Association of Secondary-School Principals**
**1201 Sixteenth Street, N. W.**
**Washington 6, D. C.**

### APPLICATION FOR MEMBERSHIP

The Student Council of ..... *Name of School*

Address for *Student Life** ..... *Street* *City or Town* *Zone* *State*

Name of Sponsor of Student Council .....

Address for *Student Life** ..... *Street* *City or Town* *Zone* *State*

Annual rates of membership are based on size of school enrollment. Fee includes enrollment of the Student Council of the school and the faculty Sponsor of the Student Council. The faculty Sponsor and the Student Council will each receive a monthly copy of *Student Life* during the membership year.

| | |
|---|---|
| L (large)—1,000 or larger | $5.00 |
| M (medium)—300 or less than 1,000 | 4.00 |
| S (small)—Less than 300 | 3.00 |

**Enroll now and membership will be paid up until June 30, 1945.**

School Enrollment this year .....
Membership fee enclosed .....

*Monthly copies of *Student Life* will be sent the Student Council of the school and the faculty Sponsor of Student Council, as listed above, until June 30, 1945. ENROLL NOW.

Date ..... Principal .....

# Secretaries of State Organizations

*Affiliated with the*

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